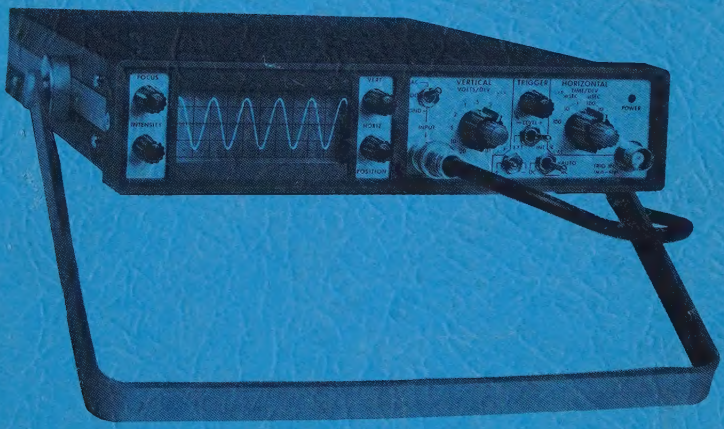
MODEL PS910

MINI-PORTABLE OSCILLOSCOPE



U-DATA CORPORATION

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TECHNICAL MANUAL

MODEL PS910

MINI-PORTABLE OSCILLOSCOPE

VU-DATA CORPORATION

AUGUST 1, 1973

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SECTION I

GENERAL DESCRIPTION

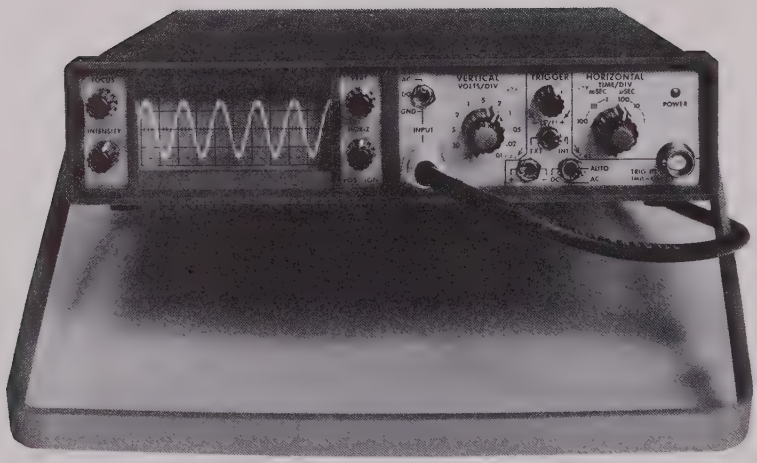


Figure 1-1. Model PS910 Mini-Portable Oscilloscope

1-1. INTRODUCTION

1-2. This manual contains complete operation, calibration and maintenance instructions for the Model PS910 Mini-Portable Oscilloscope.

1-3. The purpose of this manual is to provide the operation and maintenance information required by the equipment operator or service technician. The manual does not include information pertaining to special equipment applications, nor does it include instructions for accomplishing repairs of the type performed at the factory.

1-4. The manual is divided into eight sections. Section I provides general information regarding the purpose of the equipment, its physical arrangement, and its pertinent specifications. Section II contains information on installation and unpacking. Section III contains instructions for operating the equipment. Section IV describes the theory of operation of the equipment,circuits and mechanisms. Section V provides test, alignment, and maintenance procedures. Section VI contains a complete parts list. Section VII contains complete circuit drawings. Section VIII provides a list of recommended spares.

WARNING

When performing the power supply alignment, the instrument may be operating with the top cover removed. High Voltages, which could be lethal are accessible and extreme caution should be taken. Only screwdrivers with insulated shafts should be used for setting the adjustments. The top cover should be removed only for the duration of time required to make the alignments. The power should be off while the cover is being removed or installed.

1-5. PHYSICAL DESCRIPTION

1-6. The PS910 Oscilloscope consists of one master circuit board, which results in a thin profile and allows the instrument to be easily carried in the smallest attache case.

1-7. Integrated circuits, silicon semi-conductors, and tantalum capacitors are used to increase reliability. The printed circuit assembly has all of the principle components identified by reference designator and all diodes and tantalum capacitors are identified for polarity.

1-8. The front panel controls are divided into three basic sections: vertical, horizontal and viewing controls for ease in operation.

1-9. The 1½" x 3" cathode ray tube (CRT) is secured within a metal frame mounted to the front panel, thus bringing the display closer to the front panel to enhance the ease of viewing. A photo-positive graticule, made on clear mylar is installed between the CRT and the front panel. This eliminates the problem of realigning new tubes when replacement is required.

1-10. APPLICATION

1-11. The Model PS910 "Mini-Portable" is designed to bring laboratory quality to "on-site" DC to 20 MHz oscilloscope test and measurement applications. Its light weight (less than 8 pounds), rugged construction, small size (can fit into a tool kit or brief case) and true portability (can operate from internal batteries) makes it indispensable in servicing the sophisticated equipment which today's technology has developed.

Operating power is provided via a detachable AC line cord, or by internal batteries. Rechargeable nickel-cadmium or alkaline batteries, and if necessary, even common flashlight batteries can be used. All that is required are eight standard "C" size cells. Internal recharging circuitry and a battery case are included within all units. Furthermore, the battery circuit is designed to interrupt operation in the event nickel-cadmium cells which may be installed have reached a discharge level beyond which they would incur permanent damage.

NOTE

Damage to the Model PS910 Mini-Portable Oscilloscope caused by leaky batteries is not covered in the warranty.

1-12. PS910 BATTERY PACK

1-13. The battery pack uses eight ANSI type "C" cells connected in series and protected by a fuse. To gain access to batteries, remove the bezel and top cover.

WARNING

Before removing top cover, make sure the power switch is in the off position and the AC line cord is disconnected from the instrument back panel. This will avoid a possible lethal shock.

1-14. The cells are installed as indicated on the battery holders in Figure 1-2.

1-15. When using the instrument on batteries without the AC line cord plugged in, the minus 7.8 volt regulator will automatically turn off when the battery pack has discharged to approximately 8 volts. This prevents damage to nickel-cadmium batteries by preventing too deep a discharge. The battery pack is further protected against accidental shorting by a one amp fast blo fuse, located on the circuit board near the power transformer. Once the batteries have been discharged, they should be recharged 12-14 hours (overnight) with the power switch in the (ch) position. The power on light

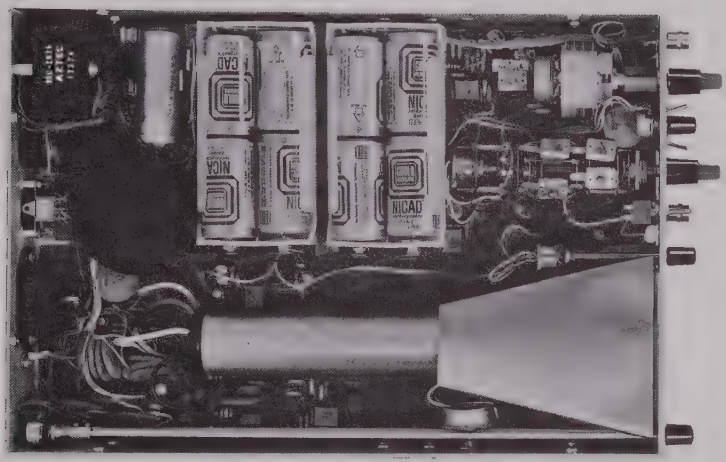


Figure 1-2. Battery Installation

will not come on in the (ch) position since the −7.8 volt regulator is not operating during battery charging. If AC line power is available, the instrument need not be taken out of use just to charge the batteries. Plug in the AC line cord before turning the power switch to operate. The internal battery charger will slowly recharge the batteries as the unit operates. An overnite charge is still recommended. In normal AC line usage, the battery charger keeps the battery pack in a trickle charged, ready to use condition. It is not necessary to have batteries installed for proper instrument operation if the instrument is connected to the AC power line.

1-16. Battery Types

The PS910 can use almost any type of sealed cylindrical "C" size primary or secondary batteries. A list of possible types to use is given in Table 1-1. For longest operation time and number of recharge cycles, the nickel-cadmium Gould Nicad SC-2 cell is recommended.

1-17. Battery Recharging

It is possible to recharge a primary battery*, but only for a limited number of cycles and under controlled conditions. The PS910 does not allow the individual cells to discharge below 1.0 volt and the constant current charger supplies the recommended 12 to 14 hour recharge rate. Ordinary carbon-zinc flashlight batteries will give the shortest operating time and the least number of recharge cycles, while nickel-cadmium cells are the best available at a larger initial cost. Cell selection should be based upon the expected battery operation usage of the instrument. The batteries should be recharged very

Battery Type	Class	Manufacturer	Part #	Approx. Oper. Time	Comment
1. Secondary	nickel-cadmium	Gould	SC2	5 Hr.	Highest Cost
2. Secondary	nickel-cadmium	Everyready	CH1.5	4.5 Hr.	Highest Cost
3. Secondary	nickel-cadmium	Burgess	CD-14	4.5 Hr.	Highest Cost
4. Secondary	nickel-cadmium	GE	GCT1.5SB	4.5 Hr.	Highest Cost
5. Secondary	alkaline	Mallory Duracell	SA14C	3-4 Hr.	Medium Cost
6. Secondary	alkaline	RCA	VS1514	3-4 Hr.	Medium Cost
7. Primary	alkaline	Everyready	E-93	4 Hr.	Medium Cost
8. Primary	alkaline	Mallory	MN-1400	4 Hr.	Medium Cost
9. Primary	alkaline	Burgess	AL-1	4 Hr.	Medium Cost
10. Primary	alkaline	RCA	VS1335	4 Hr.	Medium Cost
11. Primary	carbon zinc	any	— — —	Variable	Low Cost

Table 1-1. Battery Cell Data

soon after discharge. Cell leakage is always a problem even though the cell may be labeled sealed or leakproof. Always remove the cells when they have expired to prevent damage to the instrument. If the instrument is not to be used for an extended period of time, removal of the cells is recommended. Also, never dispose of the cells in a fire as they may explode. To avoid cell venting and overpressure, do not charge at a cell temperature below 5°C.

*Letter Circular LC965-US Dept. of Commerce, National Bureau of Standards.

1-18. Battery Life

The operating time of the battery pack is quite a variable depending in part on the following factors:

a.) State of charge and charging temperature.
b.) Continuous or intermittent discharge operation.
c.) Memorization of depth of discharge.
d.) Sustained overcharge before discharge.
e.) Discharge temperature.
f.) Cell venting.
g.) Previous storage time for primary cells and rest time after charge for secondary cells.

1-19. In general, to optimize battery operating time, turn off the instrument when not in use.

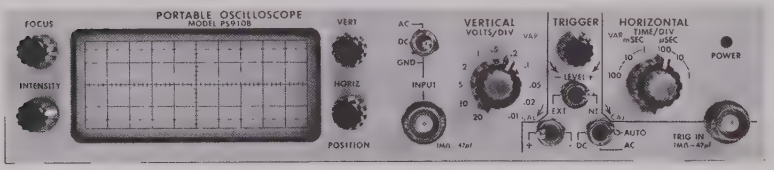
1-20. Further Battery Information

Should the user require additional information about batteries, the following sources are suggested:

a.) General Electric Nickel-Cadmium Battery Application Engineering Handbook.
b.) "EVEREADY" Battery Applications and Engineering Data (Union Carbide Co.)
c.) RCA Battery Manual, BDG-111B.
d.) RCA Alkaline Batteries, BAT-135A.

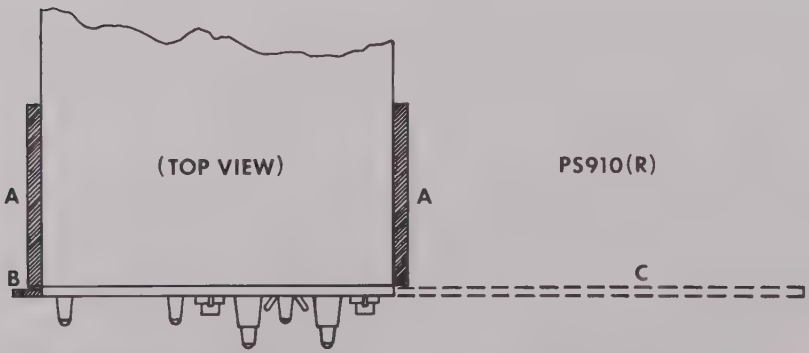
MODEL PS910

For portable applications where a low profile chassis is convenient. Includes front panel bezel, protective hood and carrying handle/stand.



MODEL PS910(R)

Ideal for panel or rack mounting where vertical panel space is restricted. A mounting kit is provided in lieu of the bezel, protective hood and handle/stand which are included with the PS910. Battery case and recharging circuitry are included as well. Dimensions: 1¾" H x 8½" W x 12" D.



The above diagram shows the rack/panel mount kit provided with the PS910(R). Parts "A" (2 each) and "B" (1 each) are included. The "A" parts are used for panel mounting through a 1/8 inch thick panel opening equal to the height and width dimensions listed above. Two 6-32 screws are used on either side to secure the "A" parts, and PS910(R), to the panel. For rack mounting applications, "B" is used as a 1 inch ear for convenient mounting to the RETMA rail, while "C" is a customer supplied filler panel.

Figure 1-3. Various Configurations of Model PS910

1-21. SPECIFICATIONS

VERTICAL DEFLECTION

BANDWIDTH: DC to greater than 20 MHz within 3 dB.
COUPLING: AC, DC or Ground, selectable. Low frequency limit with AC coupling is less than 2 Hz.
RISETIME: Less than 18 nsec.
DEFLECTION FACTOR: 10 mV/div in 11 calibrated ranges, 1-2-5 sequence; all ranges accurate to within 3% with vernier in Calibrate position. Vernier: Continuously variable between ranges; extends maximum deflection factor to approximately 50 V/div.
INPUT R AND C: 1 megohm within 2% paralleled by approximately 47 pF.
MAXIMUM INPUT VOLTAGE: 400V (DC + peak AC).

HORIZONTAL DEFLECTION

TIME BASE: 1 usec/div to 100 msec/div in 6 calibrated decade ranges; all ranges accurate to within 3% F.S. with vernier in Calibrate position. Vernier: Continuously variable between ranges (X1 to X10, uncalibrated); extends maximum sweep rate to 100 nsec/div.

TRIGGER

MODES: Automatic or manual level; "+" or "–" slope selection; internal or external. Automatic operation eliminates trigger level adjustments and is functional above 40 Hz.
COUPLING: AC and DC for both internal and external triggering; 200V maximum input voltage (DC + peak AC).
AMPLITUDE REQUIREMENTS: 0.4 div deflection (internal) or 200 mV external to 1.0 MHz, increasing to 1 div deflection (internal) or 1V external at 20 MHz. Requirements increase below 40 Hz with internal or external AC coupling.
INPUT R AND C (EXTERNAL TRIGGER): 1 megohm paralleled by approximately 47 pF.

CRT

CRT: 4 x 10 div display area; each div is ¼ inch. CRT uses low-power filament, providing a useful display promptly after turn-on. P31 phosphor normally supplied.
GRATICULE: Black; vertical and horizontal centerlines marked in 5 minor divisions per major ¼ inch division. 10% and 90% risetime reference lines included.

ENVIRONMENTAL

AMBIENT TEMPERATURE: Operating: 0°C to +55°C. Non-operating: –55°C to +75°C without batteries; –40°C to +60°C with batteries. Charging: +5°C to +40°C.
ALTITUDE: Operating: 15,000 feet maximum. Non-operating 50,000 feet.
SHOCK AND VIBRATION: Will withstand the shock and vibration conditions encountered in normal commercial shipping and handling.
HUMIDITY: Will operate up to 95% relative humidity, non-condensing.

GENERAL

PROBE COMPENSATOR: Approximately 1V p-p square wave at external jack on rear panel. Useful for self-test.

PROBE: Standard oscilloscope probes can be employed. 3 Ft. X1 alligator clip probe provided.

POWER SOURCES:

Internal DC source: Internal battery case contains provisions for 8 "C" size Nickel-Cadmium, Alkaline or Carbon-Zinc cells. Operating time using fully charged Nickel-Cadmium batteries is approximately 4 to 5 hours, depending on signal frequency and amplitude, trace intensity and ambient temperature. Internal recharging circuitry provides for charging the internal batteries when connected to AC line in the Charge mode of operation. The battery circuit is designed so that operation is interrupted should battery voltage drop to a level at which Nickel-Cadmium batteries would be damaged.

External AC source: Operates from an external AC source of 105V to 125V, or 207V to 253V; 50 to 400 Hz; approximately 17 watts.

DIMENSIONS AND WEIGHTS:

	PS910
Height	1-3/4" (4.45 cm)
Width	8-1/2" (21.50 cm)
Depth	12" (30.48 cm)
Weight	Approximately 5-1/2 pounds (2.5 kg); add 1-1/2 pounds (0.7 kg) for batteries; add 5 pounds (2.3 kg) for shipping.

INCLUDED STANDARD ACCESSORIES: X1 alligator clip probe; detachable AC line cord; 1 each Option PS9004 Technical Manual—PS910; for PS910: carrying handle/stand, bezel and front panel protective hood; for PS910(R): rack/panel mount brackets.

OPTIONAL ACCESSORIES: Option PS9001 Nickel-Cadmium Batteries (set of 8 each rechargeable "C" size cells); Option PS9003 207V to 253V AC Line Operation; Option PS9004 Technical Manual—PS910 (1 each included at No Charge); Option PS9005 Rack/Panel Mount Brackets for PS910 (included as standard No Charge accessory for PS910(R); Option PS9007 P-7 Phosphor.

1-22. ORDERING INFORMATION

MODEL PS910 Portable Oscilloscope (with carrying handle/stand, bezel and front panel protective hood; batteries not included).

MODEL PS910(R) Portable Oscilloscope (with rack/panel mount brackets; batteries not included).

OPTION PS9001 Nickel-Cadmium Batteries (set of 8 each rechargeable "C" size cells).

OPTION PS9003 207V to 253V AC Line Operation.

OPTION PS9004 Technical Manual-PS910 (one provided at No Charge with each PS910).

OPTION PS9005 Rack/Panel Mount Brackets for PS910 (included at No Charge with PS910(R).

OPTION PS9007 P-7 Phosphor.

OPTION PS9008 10:1 Probe Kit

OPTION PS9009 Viewing Hood

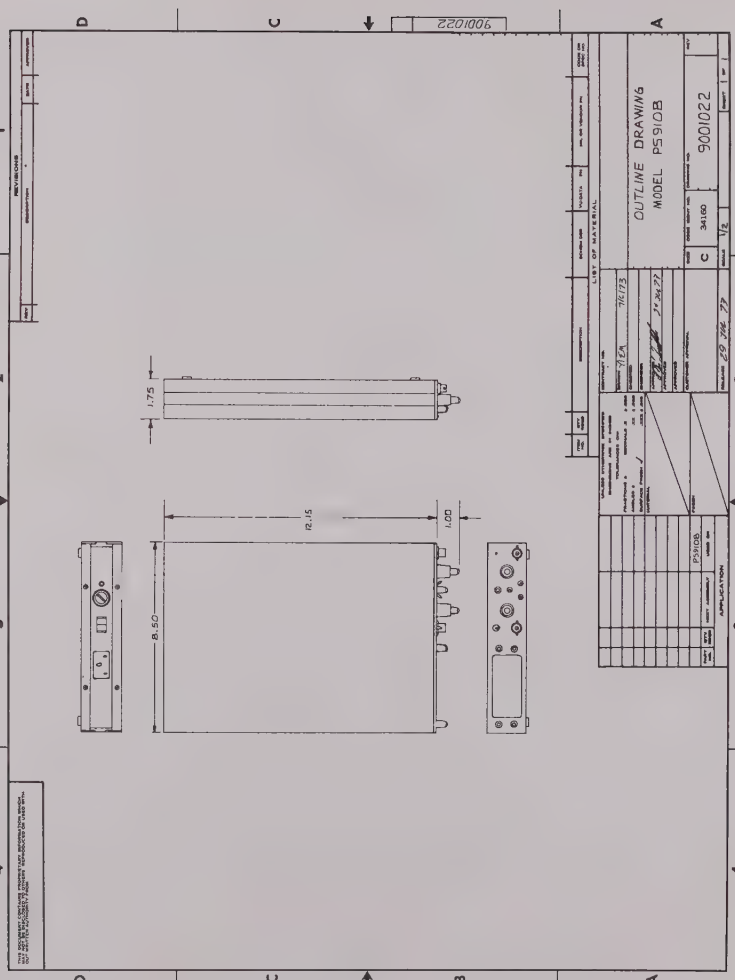


Figure 1-4. Dimension Drawing Model PS910

SECTION II

INSTALLATION

2-1. INSPECTION UPON RECEIPT

2-2. The Model PS910 is aligned, calibrated, and tested under severe environmental conditions prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made however, to assure that the instrument has suffered no damage in shipment.

a. A visual inspection of the shipping container should be accomplished prior to acceptance from the carrier. If extensive damage of the shipping container is evident, a description of the damage should be noted on the carrier's receipt and signed by the carrier's agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier within 15 days of receipt. All shipping containers and filler material must be kept for inspection.

b. A visual inspection for damage should be accomplished upon removing the instrument from the shipping container. Remove the top and bottom cover and check for loose or broken components.

2-3. Battery Operation

NOTE

A battery protection circuit within the PS910 will cause the —7.8 volt regulator to turn off when the battery pack has discharged to approximately 8 volts. This prevents battery cell reversal and subsequent harmful out-gassing. The battery pack should be charged 12-14 hours with the power switch in the charge (ch) position prior to battery operation. The LED Power light does not come on in the charge position

SECTION III

OPERATION

SECTION III

OPERATION

3-1. OPERATING CONTROLS

3-2. All of the controls necessary for the operation of the Model PS910 Mini-Portable Oscilloscope are located in such a way as to facilitate the ease in operation required by the operator.

3-3. The Model PS910 consists of one printed circuit board, with connecting wires to the front panel operating controls. Figure 3-1 shows the location of these controls on the Model PS910. Table 3-1 describes the function and location of these operating controls.

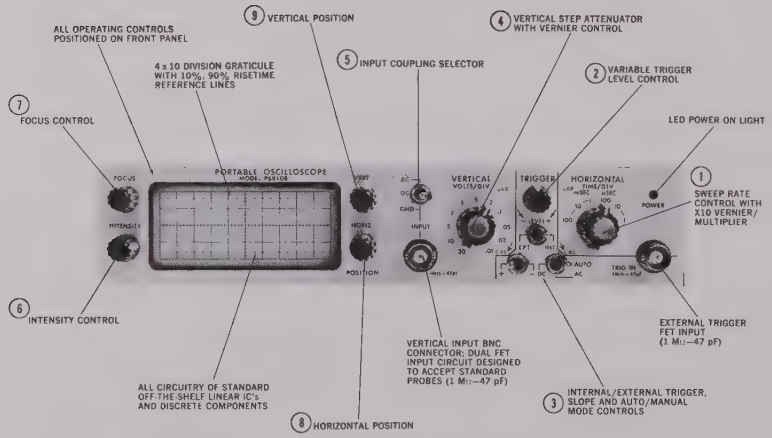

9 VERTICAL POSITION
ALL OPERATING CONTROLS POSITIONED ON FRONT PANEL
4 VERTICAL STEP ATTENUATOR WITH VERNIER CONTROL
5 INPUT COUPLING SELECTOR
4 x 10 DIVISION GRATICULE WITH 10%, 90% RISETIME REFERENCE LINES
2 VARIABLE TRIGGER LEVEL CONTROL
7 FOCUS CONTROL
LED POWER ON LIGHT
PORTABLE OSCILLOSCOPE MODEL PS910B
FOCUS
INTENSITY
VERT
HORIZ
POSITION
AC
DC
GND
INPUT
VERTICAL VOLTS/DIV
TRIGGER
HORIZONTAL TIME/DIV
POWER
1 SWEEP RATE CONTROL WITH X10 VERNIER/ MULTIPLIER
6 INTENSITY CONTROL
EXTERNAL TRIGGER FET INPUT (1 MΩ—47 pF)
VERTICAL INPUT BNC CONNECTOR; DUAL FET INPUT CIRCUIT DESIGNED TO ACCEPT STANDARD PROBES (1 MΩ—47 pF)
ALL CIRCUITRY OF STANDARD OFF-THE-SHELF LINEAR IC's AND DISCRETE COMPONENTS
3 INTERNAL/EXTERNAL TRIGGER, SLOPE AND AUTO/MANUAL MODE CONTROLS
8 HORIZONTAL POSITION

Figure 3-1. Model PS910 Operating Controls

CONTROL	POSITION	FUNCTION	NUMBER IN FIG. 3-1
POWER	ON	AC power applied when power cord connected to AC source or battery power applied when batteries installed and AC power cord removed	Located on Rear Panel
	OFF	AC or DC power removed from the instrument	
	CHG	With AC power cord connected to AC source, the batteries, Option 9001, are being charged. Power light is OFF during charge.	
HORIZONTAL TIME/DIV		Selects the Sweep Rate	(1)
	100 mSec	Measures frequency to 10 Hz.	
	10 msec	Measures frequency to 100 Hz.	
	1 msec	Measures frequency to 1 KHz.	
	100 usec	Measures frequency to 10 KHz,	
	10 usec	Measures frequency to 100 KHz.	
	1 usec	Measures frequency to 1 MHz.	
	X10 Vernier —	Continuous adjustment between each Freq. Range	
TRIGGER			
	Level	Selects the amplitude level on the triggering signal where sweep triggering occurs. This control does not function in AUTO.	(2)
	Int.	Signal trace will trigger on either the positive or negative going portion of the input signal as determined by the polarity switch.	(3)
	Ext.	External position is for external triggering on a signal applied to the external trigger input connector.	(3)
SLOPE	+ or —	Signal will trigger on the (+) positive or (—) negative going portion of the signal	(3)
AUTO OR MANUAL TRIGGER	Auto	Trigger level is adjusted automatically	(3)
	AC	The AC position blocks the DC level of the triggering signal and allows triggering to occur only on the changing portion of the signal. With frequencies below 40 Hz, use the DC position.	
	DC	The DC position permits triggering on both high and low (to DC) frequencies.	

Table 3-1. Function and Location of Operating Controls

CONTROL	POSITION	FUNCTION	NUMBER IN FIG. 3-1
VERTICAL VOLTS/DIV	.01	Input signal to the vertical circuit is not attenuated	(4)
	.02	Attenuated to where .02V p-p equals 1 div	
	.05	Attenuated to where .05V p-p equals 1 div	
	.1	Attenuated to where .1V p-p equals 1 div	
	.2	Attenuated to where .2V p-p equals 1 div	
	.5	Attenuated to where .5V p-p equals 1 div	
	1	Attenuated to where 1.0V p-p equals 1 div	
	2	Attenuated to where 2.0V p-p equals 1 div	
	5	Attenuated to where 5.0V p-p equals 1 div	
	10	Attenuated to where 10.0V p-p equals 1 div	
	20	Attenuated to where 20.0 V p-p equals 1 div	
VERNIER		Uncalibrated vernier allows continuous adjustment between ranges.	
INPUT COUPLING	AC	Input signal is AC coupled to the vertical input	(5)
	DC	Input signal is DC coupled to the vertical input	
	GRD	The input signal is grounded	
INTENSITY	VAR	Controls brightness of the display	(6)
FOCUS	VAR	Used in conjunction with the INTENSITY control for obtaining a well-defined display	(7)
HORIZONTAL POS.	VAR	Positions the display along the horizontal axis of the CRT	(8)
VERTICAL POS.	VAR	Positions the display along the vertical axis of the CRT	(9)

Table 3-1. Function and Location of Operating Controls (Continued)

3-4. CONNECTORS AND FUSES

3-5. The connectors used in the Model PS910 are the input BNC, the external trigger BNC and the AC power connector, J203 shown in Figure 3-2. The input and trigger connectors, J201 and J202, respectfully, are shown in Figure 3-1.

3-6. The Model PS910 uses 2 fuses. Fuse F201 (located on the rear panel) is the power fuse and is a 1/4 amp Slo-Blo for 105-125V operation and 1/8 amp Slo-Blo for 207-253V operation. Fuse F1 is the battery protection fuse and is a 1 amp Fast-Blo, located on the Master Board.

Figure 3-2. Rear View of Model PS910

3-7. ACCESSORIES

3-8. Battery Case

3-9. Each Model PS910 includes a battery case as shown in Figure 3-3.

Figure 3-3. Battery Case with Batteries Installed

3-10 Protective Hood

3-11. A tough vinyl protective hood is furnished with the Model PS910. This hood protects the front panel controls and CRT during transporting. Figure 3-4 shows a Model PS910 with its hood.

Figure 3-4. PS910 with Protective Hood and Handle

NOTE

THE HANDLE USED ON THE MODEL PS910 MINI-PORTABLE OSCILLOSCOPE IS A MULTI—POSITION POSITIVE LOCK. TO CHANGE POSITION, DEPRESS THE BUTTONS AND MOVE THE HANDLE TO THE DESIRED POSITION.

3-12. Input Cable

3-13. An input cable is included in each Model PS910 Mini-Portable Oscilloscope.

3-14. TRACE ANGLE CONTROL

3-15. A trace angle coil is mounted around the CRT. An adjustment of the current in the coil is made by R148 which is reached from outside the instrument case by a hole in the left side rail located just forward of the handle mounting support.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL

4-2. The PS910 Portable Oscilloscope is composed of the following basic circuits:

a.) Wideband, variable gain, vertical deflection amplifier.

b.) Controllable trigger generator circuit.

c.) Combination linear sweep generator and horizontal output amplifier.

d.) Blanking circuit.

e.) Power supply.

4-3. Refer to Figure 4-1 Block Diagram and Figure 7-1 Schematic Diagram to aid in understanding the theory of operation. 200 series reference designator parts are mounted off the printed circuit board.

4-4. VERTICAL DEFLECTION AMPLIFIER

4-5. The Vertical Deflection Amplifier is a wideband DC to 20 MHz, single ended input, differential output, amplifier having eleven stepped gain ranges with a two and one half to one gain decrease vernier control. Input signals are either AC or DC coupled into the amplifier's one megohm input impedance. The active circuitry consists of a dual FET buffer amplifier (U-1), a cascade bipolar buffer amplifier (U-2), an IC video amplifier (U-3), and a discrete component vertical output amplifier (Q 5, Q 6). U-1, U-2 and U-3 are located near the vertical attenuator switch (S-202 a, b, c), while the vertical output amplifier is located near the vertical calibration pot. Vertical positioning is provided by emitter followers Q 1 and Q 2. The trigger take off emitter follower is Q 12. Current sources Q 3 and Q 4 complete the active elements of the Vertical Deflection Circuit.

4-6. Detailed Description

4-7. Switch S-201 couples the vertical input signal from BNC connector J201 through C201 for AC coupling, or direct for DC, to the vertical attenuator switch S-202. S-201 also has a position to ground the input to the vertical amplifier to aid in positioning the CRT trace.

4-8. The vertical attenuator switch, S-202, has three wafers. Wafers A and B switch the input signal either direct or a divide by 20 attenuator, or a divide by 400 attenuator. The C wafer changes the gain of video amplifier U-3. The gain relationships are shown in Table 4-1.

4-9. At low frequencies the vertical attenuator resistors provide the attenuation while the shunt capacitors become dominant at high frequencies. Attenuator peaking is controlled by C 204 and C 206. C 202 and C 203 maintain a constant input capacity so that an external divide by 10 probe may be used. R 2 supplies the one megohm input resistance. R 1 and C 21 provide the series impedance for overload protection diodes CR1 and CR2. Under an overload signal condition, the excess voltage is clamped by these diodes to the plus and minus power supplies, thus protecting the input FET transistor.

4-10. The input FET dual transistors, U-1, are connected as source followers which have a very high input impedance and low output impedance. Initial Vgs difference between the two transistors is

Switch Pos V/DIV	Input Atten.	U3 Gain	Combined Gain
.01	X1	50	50
.02	X1	25	25
.05	X1	10	10
.1	÷20	100	5
.2	÷20	50	2.5
.5	÷20	20	1
1.0	÷20	10	0.5
2.0	÷400	100	0.25
5.0	÷400	40	0.1
10.0	÷400	20	0.05
20.0	÷400	10	0.025

Table 4-1. Vertical Attenuation - Gain Relationship

adjusted out by R11. R205 is the vertical gain vernier which decreases the gain by a factor of 2.5 to 1. The high input impedance of U-2, twin Darlington connected emitter followers, allows linear operation of potentiometer R205. Adjustment R16 compensates for differences in Vbe of U-2 and the input stage of U-3. L1, C2, L2, C5 and C7 decouple the power supply lines.

4-11. Differential input and output IC video amplifier, U-3, has its gain controlled by resistors connected to terminals 4 and 9. An open between these pins sets the gain to ≈10. Power supply decoupling is provided by R18, C 9 and R19, C8. The internal trigger is taken from pin 6 of U 3 and DC restored in diodes CR5 - CR9 so that the output voltage of emitter follower Q12 is symmetrical about ground. R150 calibrates the gain steps of U-3.

4-12. The discrete component output amplifier is composed of two common emitter amplifiers, Q5 and Q6, connected for differential input and output. Adjustment R42 changes the gain of the output amplifier to accommodate for differences in vertical deflection sensitivity between CRT's. R41 and C17 are factory selected values to optimize the very high frequency performance of the output amplifier. Emitter followers Q1 and Q2, controlled by the vertical position control, R206, cause the output amplifier to differentially trade current thus vertically positioning the CRT trace. Q3 and Q4 provide the collector loads for Q5 and Q6.

4-13. TRIGGER GENERATOR

The Trigger Generator is basically a squaring amplifier which converts analog input signals into fast risetime squarewaves for use in controlling the start of the horizontal sweep. In the automatic trigger mode of operation, the trigger generator operates as a 40 Hz free running multi-vibrator. This provides a trace on the CRT in the absence of an input signal. For input signals whose frequency is above the free running rate, the trigger generator is an IC voltage comparator, U-4, which has high gain and very fast response. With Q18 and Q19, it functions as a Schmidt Trigger and in Auto as a free running, triggerable multi-vibrator. FET source followers, Q14, Q15 provide a high 1 megohm input impedance for external signals to the Trigger Generator. Table 4-2 details the various controls and modes of operation of the Trigger Generator.

CONTROL	POSITION	FUNCTION
1. Trig Source Sw.	a) Int	Oscilloscope triggers from the vertical waveform.
	b) Ext	Oscilloscope triggers from an external signal supplied to the Trig Input BNC.
2. Trig. Mode Sw.	a) AUTO	Triggers are generated at approximately 40 Hz rate or synchronized to a higher frequency. Provides a trace in the absence of any input signal. Trig signals are AC coupled.
	b) AC	Signals are AC coupled to trig generator.
	c) DC	Signals are DC coupled to trig generator.
3. Trig Polarity Sw.	a) Plus +	Selects positive slope for sweep start.
	b) Minus –	Selects negative slope for sweep start.
4. Trigger Level Control	Variable Single Turn	Positions sweep start up and down waveform. This control is inoperative when AUTO mode is selected.

Table 4-2. Trigger Controls

4-14. Detailed Description

Switch S203 routes the input signal either from the EXT Trig input BNC connector, J-202, or from the internal trigger source, the emitter of Q12, to the trigger mode switch, S204 a, b. Section "a" of this switch controls the AC or DC coupling of the trigger input signal while section "b" changes the trigger generator U-4 into a 40 Hz free running multi-vibrator by switching in or out C25 and C26. One megohm input impedance is provided by R66. Clamp diodes CR14 and CR15 protect the input FET source follower transistor Q14 by shorting overload signals to the power supplies through the impedance of R10, R65 and C23 FET transistor Q15 provides a matching source voltage for Q14 and is matched at the factory for Δ Vgs less than 0.1 volt at circuit ID. Potentiometer R209, the Trigger Level Control, varies the DC voltage at the gate of Q15 above and below zero volts. In the Auto Mode, Q16 acts as a switch shorting the gate of Q15 to ground. Q17 activates Q16 when operated by the Mode Switch. Polarity switch, S-205 a, b, acts as a reversing switch in selecting the inputs to emitter followers,Q18 and Q19.

4-15. The trigger generator is an IC voltage comparator, U-4, which provides a digital output state dependent upon the polarity of its input terminals. R81 and R87 act as a voltage divider causing the comparator to act as a Schmidt trigger. R86 in conjunction with C25 and C26 when they are not shorted by the Mode Switch allows the comparator to oscillate at about 40 Hz. In this Auto mode input signals are still coupled through the capacitors to synchronize the comparator to the input trigger signal. Diodes CR16 and CR17 protect the comparator from overload signals. Power supply decoupling is provided by R91, C28, R88 and C29. R89 and R90 establish the proper common voltage at pin 1 of the comparator. C31 decouples this pin 1 voltage to ground.

4-16. SWEEP GENERATOR AND HORIZONTAL OUTPUT AMPLIFIER

4-17. The Sweep Generator produces a linear zero to 20 volt ramp, through which the Horizontal Output Amplifier moves the CRT beam from the left side to the right. The Sweep Generator is controlled by the sweep control circuit. This circuit starts the ramp in synchronism with a trigger pulse, rejects other trigger pulses while the ramp is sweeping, resets the Sweep Generator to zero volts when the blanking monostable has fired and finally, controls the blanking flip flop to turn the beam on and off. An internal stability adjustment sets the operation of the sweep control circuit.

4-18. An IC operational amplifier U-5 is connected as an integrator to form the linear Sweep Generator. FET switch, Q24, resets the integrating capacitor to zero volts after every sweep. The blanking monostable assures that the integrating capacitor has been completely discharged before allowing the trigger generator to initiate the next sweep. The Sweep Generator has six fixed decade ranges and one variable ten to one range. This provides a sweep range from 0.1 seconds per division to $\approx$100 nanoseconds per division.

4-19. The Horizontal Output Amplifier is a discrete component differential input and output amplifier with sufficient gain to amplify the output of the Sweep Generator to drive the horizontal deflection plates of the CRT. One input to the amplifier is driven by the Sweep Generator and the other by the horizontal position control.

4-20. Detailed Description

4-21. Sweep Generator

4-22. IC operational amplifier U5 integrates the constant current derived from the network R101, R102, R104, R105 as selected by the Time Per Div switch S1c. The proper integration capacitor is selected by S1b. C 35 is matched to C 36 to plus or minus 1% and the combination of C 37 and C 38 is ratioed to the matched capacitor set by means of the adjustable capacitor C 38. A ten to one increase in integrating current is provided by R149 supplying a voltage from ground to minus 7.8V. FET Q24 discharges the integrating capacitor after every sweep. The end of the sweep is determined by the blanking monostable, Q25, Q26, whose firing point is adjusted by sweep length adjustment R107. The monostable time is determined by capacitor C 45 for the one and 10 microsecond per div. ranges, by C 42 for the 100 microsecond and 1 millisecond ranges, and by C 41 for the 10 and 100 millisecond ranges.

4-23. The sweep control circuit, Q20, Q21, Q22, Q23 is actuated by differentiated trigger pulses from U4 through C30 and voltage levels which activate diode CR19 from the collector of inverter Q27. Q22 and Q23 form a complementary NPN/PNP emitter follower whose input signal drives the FET reset switch and whose output supplies the blanking flip flop control pulse. The stability control R93 is adjusted for a triggered sweep and may cause the sweep to free run if maladjusted.

4-24. Horizontal Output Amplifier

The Horizontal Output Amplifier is composed of Q8, Q9, Q11, Q10 and Q13. Emitter follower Q7 provides impedance buffering for the Horizontal Position Control R207. Q13 is a constant current drain for differential amplifier transistors Q9 and Q10. Q8 and Q10 buffer the amplifier feedback summing modes. The gain is adjusted by R64 to compensate for variations in CRT horizontal deflection sensitivity. High frequency compensation is provided by L3, L4, C19 and C22.

4-25. BLANKING CIRCUIT

To turn off the CRT trace, the blanking grid must be driven more negative than the cathode voltage. The intensity of the trace depends on how close the blanking grid returns to the cathode voltage. A complementary NPN/PNP four transistor flip flop is used to drive the blanking grid with very fast rise and fall times. The intensity is controlled by varying the supply voltage to this flip flop. Since the Blanking Circuit is located at about minus 2000 volts, the flip flop is triggered by pulses coupled via C 68.

4-26. The blanking flip flop is composed of Q36, Q37, Q38, and Q39. At the end of the sweep, the sweep control circuit puts out a plus change in voltage level which turns on Q39 through capacitor C68. This pulse also turns off Q36 through C69. Q39 turning on causes current to flow through R143 and the base emitter junction of Q38. This turns on Q38 but the degree of saturation is controlled by R140, CR59 and R141 for faster switching times. The blanking grid is thus connected to the −2045 volt supply cutting off the CRT. A negative input pulse causes the flip flop to switch to opposite state. However, the turn on voltage is controlled by the DC voltage output of Q35 as adjusted by the front panel intensity control R210. Protection diodes CR20 and CR21 keep high voltage transients from affecting the sweep circuits. Zener diode CR57 and C67 raise the CRT cathode voltage toward ground so that the blanking flip flop does not have to swing more than 45 volts.

4-27. POWER SUPPLY

Power is drawn either from the AC power line or from the internal battery pack when the power switch is switched to on depending upon the AC line voltage. Whenever the AC line falls below about 105V rms, the batteries supply the current to operate the oscilloscope. Should the battery pack voltage drop below 8V, the minus 7.8 volt regulator stops regulating. This prevents the battery pack from becoming deeply discharged with consequent damage to the individual cells. When the AC line voltage is within normal limits, the batteries are trickle charged so that they will always be ready for use. Placing the power switch to the (ch) position allows the battery pack to be completely charged overnite (about 12-14 hours).

4-28. The power supply consists of a step down AC line transformer, bridge rectifiers and filter capacitor, a battery charger constant current regulator, battery pack, −7.8V DC regulator and a DC to DC converter supplying the other DC and filament voltages.

4-29. Unregulated DC Supply

AC line voltage is conducted through the line fuse and power switch to the primary of T201. The secondary voltage of T201 is rectified by CR25-28 and filtered by C46 to a nominal 17 volts DC.

4-30. Battery Charger Constant Current Regulator

Q28 (mounted on the rear panel) operates as a constant current DC supply having two current rates; one rate for operating the oscilloscope, and a second lower rate for charging the battery pack. The two rates are switched by S206b, the rear panel power switch, which selects either the parallel combination of R120 and R121 or R122. The upper voltage limit of the constant current supply is controlled by CR29, CR30, CR31 and CR32. This voltage limit prevents overcharging the battery pack by tapering off the charge as the battery pack voltage rises.

4-31. Minus 7.8 Volt Regulator

The output of U6 is coupled through Switch Transistor Q30, through CR23 and CR24 to Emitter Follower Q31 which drives the Series Pass Transistor Q32. In normal operation Q29 and Q30 are both turned on. When the −7.8V regulator will not regulate due to either excessive load or low input voltage from a discharged battery pack, U6 output voltage rises, turning off Q29, Q30, Q31 and Q32. Time constant C49 and R126 allows the protection circuit to take effect after the initial turn on transients have died out.

4-32.DC to DC Converter

Toroidal transformer, T1, and transistors Q33 and Q34 form a square wave power oscillator operating at about 5 KHz. The plus 6.8V supply is rectified and filtered from the primary of the transformer. The Cal output Voltage is obtained by clipping the square wave primary voltage in CR39 and CR40. CR41 - 44 and C57 rectify and filter the +180V supply. CR45-48 and C58 rectify and filter the +30V supply. CR49-52 and C59 rectify and filter the floating −45 volt supply which is connected to the −2000 volt supply making a −2045 volt supply. Rectifiers CR40 through CR49-52 and capacitors C60 through C67 are connected as a voltage quadrupler to supply −2000V. The 1.5 volt O-P filament voltage is not rectified but supplied to the CRT as a 5 KHz square wave. When the −7.8V regulator is operating, current through DS201 causes the power on light to glow red.

NOTE

When the instrument is triggered externally from signals larger than approximately 6 volts, internal overload protection is provided. An external trigger attenuator is recommended however, to avoid any possible trigger signal coupling into the vertical deflection circuit whenever large external trigger signals are used.

WARNING

When performing the power supply alignment, the instrument may be operating with the top cover removed. High voltages, which could be lethal are accessible and extreme caution should be taken.

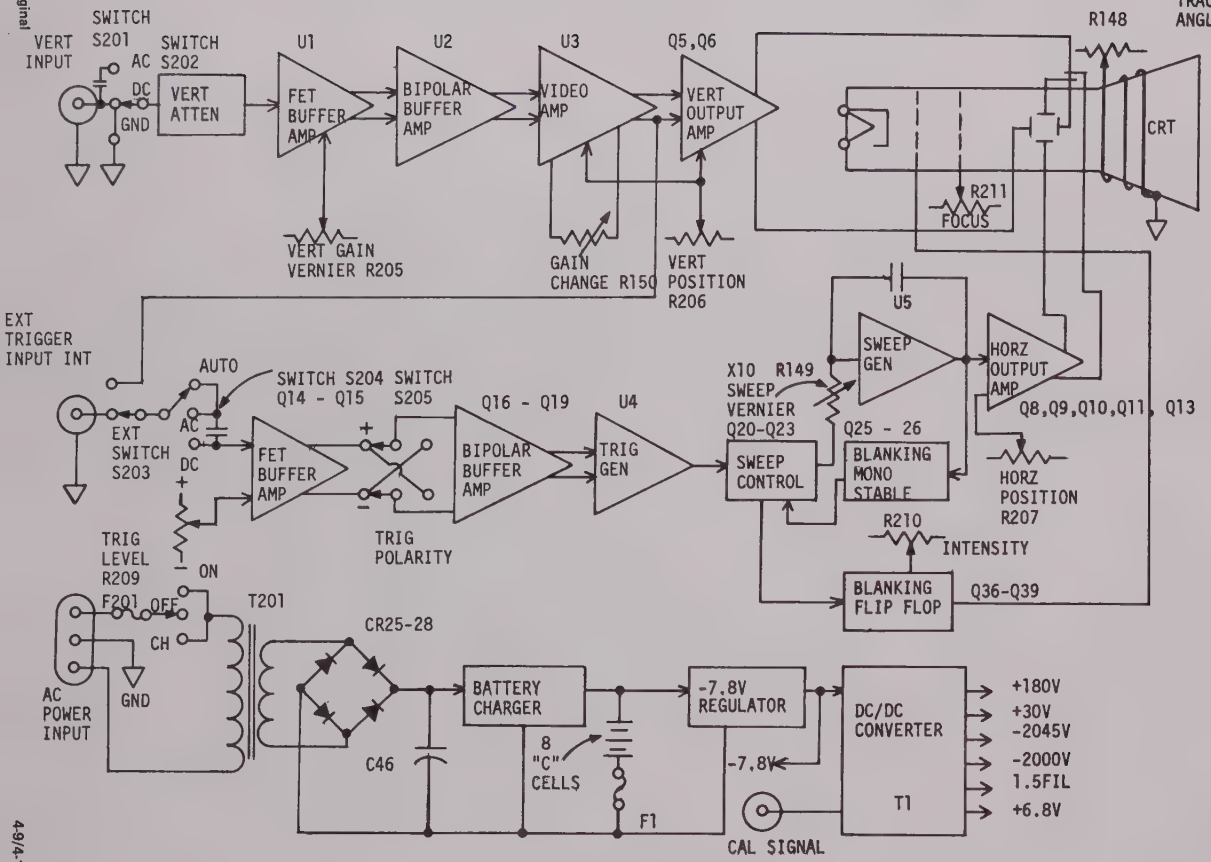


Figure 4-1. Block Diagram Model PS910

SECTION V

MAINTENANCE

5-1. GENERAL

5-2. The following procedure provides the information necessary for technical personnel to align and calibrate the Model PS910 Mini-Portable Oscilloscope. The alignment should be accomplished at regular periodic intervals to ensure the proper operation of the instrument.

5-3. The alignment and calibration of the Model PS910 is covered in this procedure. The calibration of the Power Supply portion should always be done prior to the Signal portion.

WARNING

When performing the power supply alignment, the instrument may be operating with the top cover removed. High voltages, which could be lethal are accessible and extreme caution should be taken. Only screwdrivers with insulated shafts should be used for setting the adjustments. The top cover should be removed only for the duration of time required to make the alignments. The power should be off while the cover is being removed or installed.

5-4. Test Equipment Required

5-5. The following test equipment is required to align and calibrate the instrument. The model number and manufacturer may be substituted if the specifications of the substituted units are equal to or better than the listed equipment.

1. Sine Wave Generator	HP Model 651B
2. Square Wave Generator	HP Model 211B
3. Frequency Counter	HP Model 5321B
4. RMS Voltmeter	HP Model 3400A
5. DC Voltmeter	Honeywell Model 500
6. Pulse Generator	SD Model 101
7. Constant Amplitude Generator	Tek Model 191

5-6. LOCATION OF CONTROLS FOR ALIGNMENT

5-7. Figure 5-1 shows the location of the front panel controls. Figure 5-2 shows the location of the controls on the Master Board Sub-Assembly. Figure 5-3 shows location of rear Panel Controls and Figure 5-4 shows location of Controls mounted on Vertical Switch Sub-Assembly.

5-8. POWER SUPPLY CALIBRATION

5-9. To measure the power supply voltages in the Model PS910 it is necessary to remove the top and bottom covers. ALWAYS REMOVE POWER PRIOR TO REMOVAL OF COVERS. When batteries are utilized, the Power Switch, as shown in Figure 5-3 must be in the OFF position.

5-10. Minus 7.8 VDC Supply

5-11. With a DVM, monitor the –7.8 VDC supply. Adjust R131 for a regulated output voltage of –7.8 VDC ± 10 mv.

5-12. Other VDC Supplies

5-13. With a DVM, confirm the other Supply Voltages are:

1) +6.8 VDC ± 10%
2) +30 VDC ± 10%
3) +180 VDC ± 10%

5-14. There are no adjustments for these voltages as they are controlled by the –7.8 VDC.

NOTE

DO NOT ATTEMPT TO MEASURE THE –2000 AND THE –2045 VDC circuit without a Divider Input.

5-15. PRE-ADJUSTMENTS

5-16. After a 10 minute warmup has been given, preset the controls as shown in Table 5-1. Location of these controls is shown in Figure 5-1.

Vertical Position	Mid-Range
Horizontal Position	Mid-Range
Trigger Polarity	+
Focus	Mid-Range
Intensity	CW
Input Mode	GRD
Trigger Level	Mid-Range
AC/DC/AUTO	Auto
Ext/Int	Int
V. Volt/Div.	.1
V. Vernier	Cal
H Time/Div	1 msec
X10 Vernier	Cal
Power Switch	ON

Table 5-1. Control Pre-Adjustments

5-17. Control Pre-Adjustments

5-18. Adjust the vertical and horizontal position controls for a centered sweep. Adjust the focus and intensity controls for a desired display.

NOTE

A constant trace with maximum intensity may burn the phosphor on the cathode ray tube (CRT). THE WARRANTY ON THE CRT DOES NOT COVER PHOSPHOR BURNS.

5-19. Using the sine wave generator, with a load of 50 ohms, (1) apply a 0.4 V p-p sine wave @ 1 KHz to the input BNC connector.

5-20. A stable 1 KHz sine wave should be displayed on the CRT. If the signal does not trigger properly, adjust the stability control potentiometer R93 for a stable display at a point midway between where the display disappears and where the display free runs or becomes unstable.

NOTE

A CW rotation will cause the display to disappear and a CCW rotation will cause the display to become unstable.

5-21. Trigger Polarity

5-22. With the trigger polarity switch, (3), located on the front panel, as shown in Figure 5-1, in the + position, the start of the display should occur during the positive slope of the cycle. Switch the polarity to – and the start of the display should occur during the negative slope of the cycle.

5-22. With the Trigger Mode Control in Auto, adjust R 82 so that the start of the sweep occurs at the zero level of the displayed sine wave.

5-23. To verify the variable trigger level control (2), position the Auto/AC/DC Mode control switch (3) to AC and rotate the trigger level potentiometer for a steady trace.

5-24. External Trigger

To verify the operation of the external trigger, place the Ext/Int switch (3) as shown in Figure 5-1 to the EXT position and apply an input from the sine wave generator to the external trigger input. Adjust the sine wave generator for an output of 200 mv p-p. The display should continue to be a stable display of 1 KHz.

5-25. VERTICAL ACCURACY

5-26. Position the controls as follows:

1) Vert Atten – 1V/div
2) Trig. Switch – Internal
3) Trig. Mode Switch – Auto
4) Trig. Polarity – +
5) Input Coupling Switch – Gnd

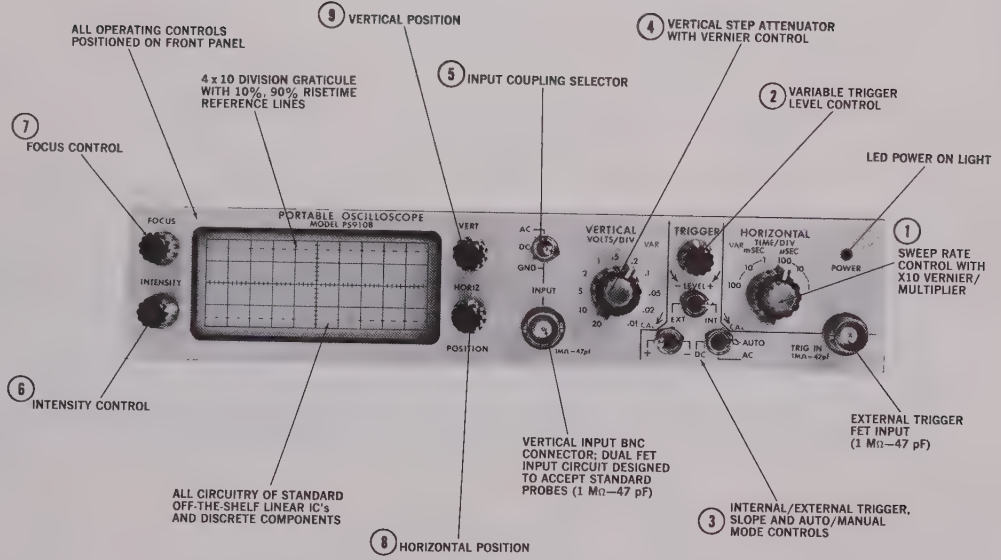


Figure 5-1. Location of Front Panel Controls

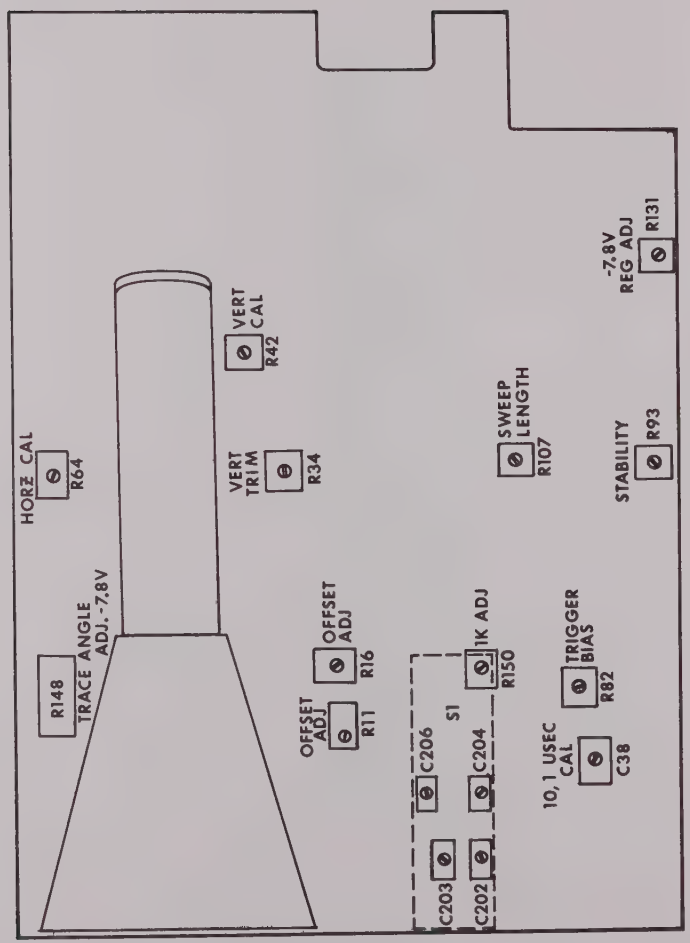


Figure 5-2. Control Locations on Master Board Sub-Assembly

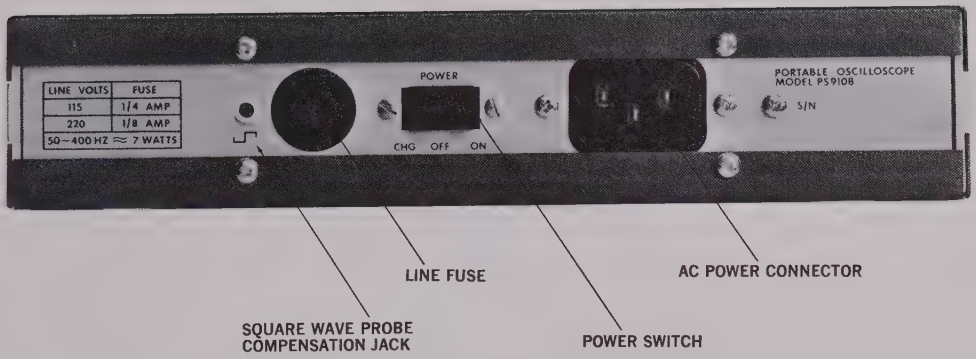


Figure 5-3. Location of Rear Panel Controls

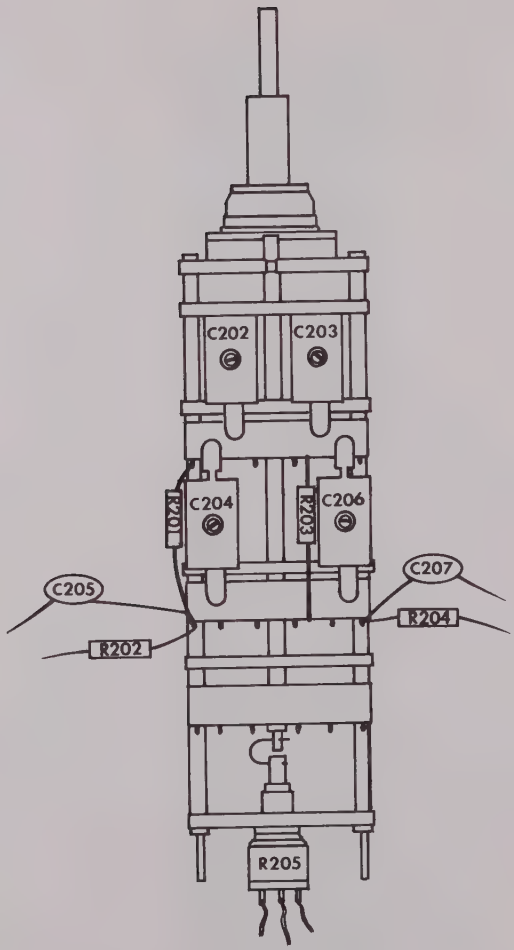


Figure 5-4. Location of Controls, Vertical Switch Sub-Assembly

5-27. DC SHIFT

5-28. Rotate the Vertical Vernier Control from one end to the other and check for any DC shift. If the level shifts, adjust R11, located on the Master Board Sub-Assembly as shown in Figure 5-2 for a minimum DC shift.

5-29. Rotate the Vertical Attenuator control between the 1V/div and 2V/div attenuator setting. Adjust R16 on the Master Board Sub-Assembly for minimum DC shift.

5-30. SYMMETRY ADJUSTMENT

5-31. Set the Vertical Attenuator to 1V/div and the vert input coupling switch to DC. Connect the sine wave generator to the vertical input and adjust the generator for a full scale display at 1 KHz. Adjust R34, on the Master Board Sub-Assembly for a symmetrical sine wave display.

5-32. ATTENUATOR COMPENSATION

5-33. Connect a square wave oscillator to the input and adjust the oscillator to 100 mv output @ 1 KHz. Set the Vertical Attenuator switch to 50 mv/div and observe the square wave signal on the CRT. Adjust the Horizontal Switch for a display of approximately 2 cycles. The square wave should be free from abnormal rounding or peaking. Figure 5-5 shows the square wave output signal in an over, under and properly compensated waveform. Switch the Vertical Attenuator switch to the 0.1 Volt/Div position and increase the oscillator output for a suitable display. Capacitor C204 may be adjusted to square the signal. Switch the Vertical Attenuator switch to the 2 Volt/Div position and increase the oscillator output for a suitable display. Adjust capacitor C206 if required.

5-34. Connect a divide by 10 input probe to the input and set the Vertical Attenuator switch to the 50 mv/div position. Using a square wave source at 1 KHz, adjust the probe for the best square wave. Switch the Vertical Attenuator to the 0.1 V/div position and adjust capacitor C202 for the same waveform previously obtained changing the oscillator amplitude as required. Switch the Vertical Attenuator to the 2 V/div position and adjust capacitor C203 for the best square wave.

5-35. VERTICAL GAIN ACCURACY

5-36. Set the Vertical Attenuator to the .1 V/div range and Vert Vernier to calibrate. Apply a .4 V p-p signal, at 50 KHz, from the constant amplitude generator to the vertical input. Adjust the vertical calibration control, R42, for a full scale display. Set the vertical attenuator to the 50 mv/div range and reduce the amplitude of the generator to 200 mv p-p. Adjust R150 on the Master Board Sub-Assembly, for a full scale display.

Check and note the accuracies of all of the Vertical Attenuator ranges. If necessary, readjust the vert gain accuracy on the 50 mv/div and 100 mv/div ranges so that all ranges fall within the vertical accuracy specification limits.

5-37. HORIZONTAL ACCURACY

NOTE

To remove the Front Panel Control knobs, remove the button from the front portion by using a small flat blade screwdriver which exposes a screw. Loosen the screw and remove knob. The large selector switch knobs are removed by using a 1/4 inch spin tight wrench.

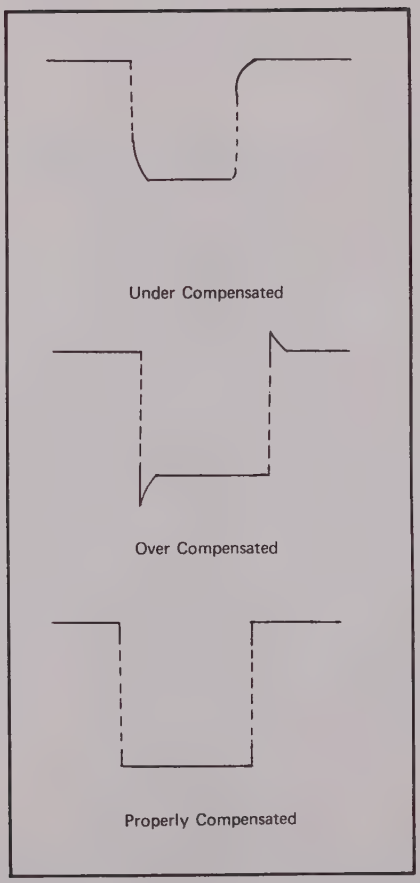


Figure 5-5. Attenuator Compensation

5-38. Position the front panel controls as follows:

1)	Horz. Vernier	CAL
2)	Horz. Time/Div	1 mSec/Div
3)	Trig. Switch	Int.
4)	Trigger Mode	AUTO

Connect an oscillator to the input and set the frequency to 1 KHz ±1%. Adjust the Vertical Attenuator switch for a suitable display.

5-39. Horizontal Calibration

5-40. The display on the CRT should be 1 cycle for each division on the graticule. For ease in observation, the signal should be positioned so the peaks of each cycle are on the center horizontal line of the graticule, (vertical position) and the peak of each cycle on a vertical division line (horizontal position). The peaks must align within the division graduation with ±3% of full scale (0.3 division). Potentiometer R64 may be adjusted if required.

5-41. Switch the oscillator to 100 Hz ±1% and the Horz. Time/Div Switch to 10 msec. Check the calibration on this range and, if necessary, split the difference between the two ranges by readjusting the Horz. Cal Control, R64.

5-42. Switch the oscillator to 100 KHz ±1% and the Horz Time/Div Switch to 10 usec per div. Adjust C38 for 1 cycle/div.

5-43. Switch the oscillator to 1 MHz ±1% and the Horz Time/Div Switch to 1 usec per Div. Check for 1 cycle per div and if necessary, split the difference between the two ranges by readjusting C38.

5-44. SWEEP LENGTH

5-45. The length of the sweep should be 12 ± 1 division. To determine the length, adjust the horizontal position control for the sweep to start on the 1st vertical line of the graticule. Rotate the horizontal position control CCW until the peak of the last sine wave has moved 2 divisions. The end of the sweep should now be located approximately on the last vertical line of the graticule. Potentiometer R107 on the master board as shown in Figure 5-2 may be adjusted if required.

5-46. This completes the alignment of the Model PS910 Mini-Portable Oscilloscope, Figure 5-2 includes the Trace Angle adjustment which positions the horizontal trace on the horizontal axis. (Reference paragraph 3-15.)

5-47. Figure 5-6 and 5-7 are used to show the parts locations and their reference designators on the master board.

NOTE

When replacing components on a printed circuit board, care should be taken to prevent damage to the board from excessive heat or solder bridges. Obvious damage caused by improper techniques will negate the warranty. Soldering irons used should be less than 40 watts.

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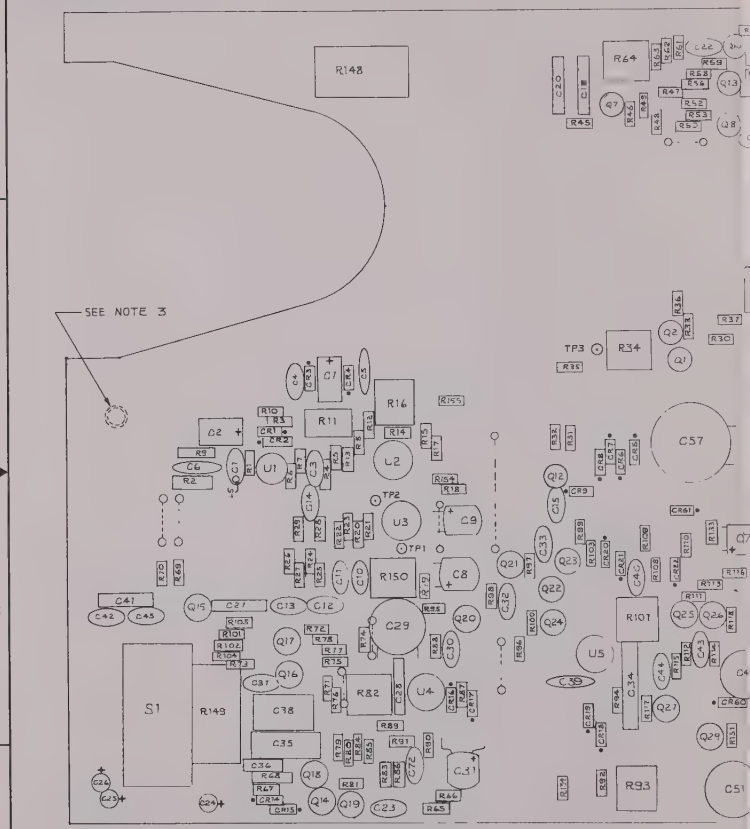


NOTES: UNLESS OTHERWISE SPECIFIED

1- ◄(DOTS); INDICATE CATHODE LEAD OF DIODES.
2- +; INDICATES POSITIVE LEAD OF CAPACITORS.
3- PEM FASTENER KFZ-440, INSTALL FROM FAR SIDE & SOLDER TO ETCH.
4- PEM FASTENER KFZ-440, INSTALL FROM NEAR SIDE (2 PLACES).
5- T1 MOUNTED OFF BOARD WITH SPACER (ITEM.36).
6- O----O; INDICATES BUSS WIRE JUMPER.

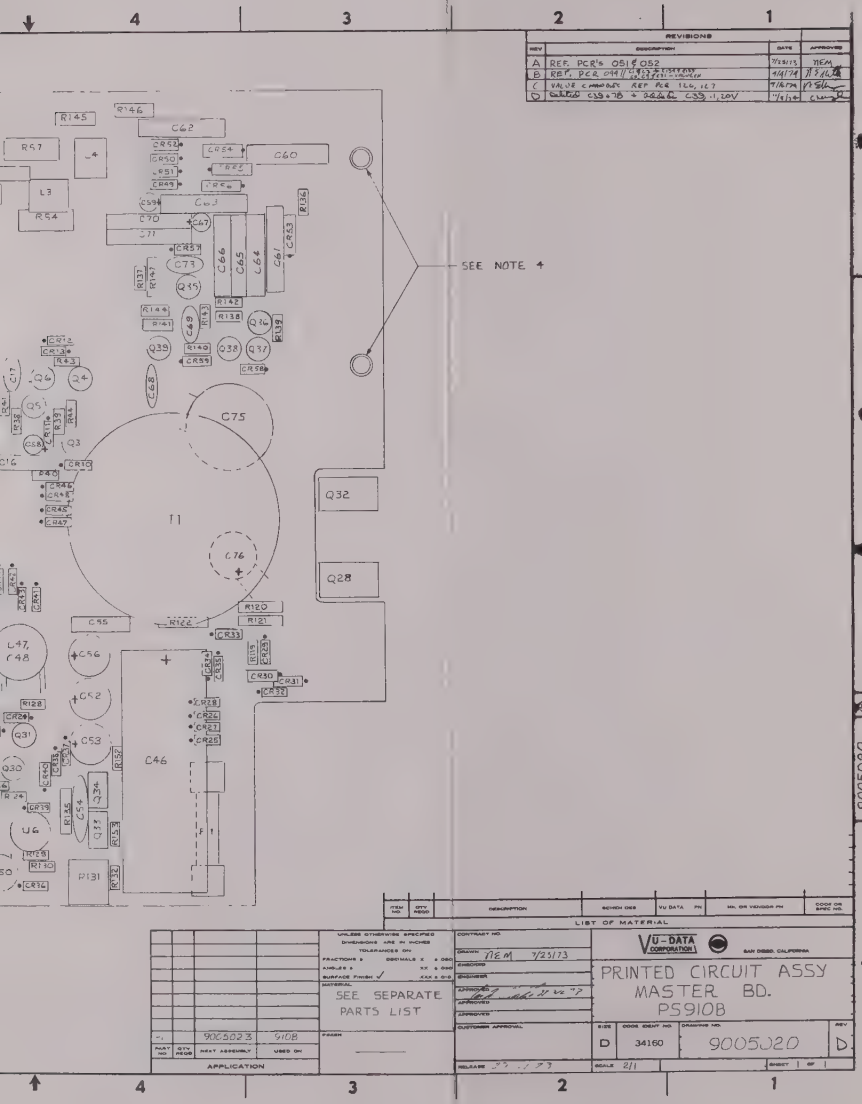


Figure 5-6. Parts Location for Master Board Sub-Assembly

Figure 5-7. Master Board Assembly

SECTION VI

PARTS LIST

Mfg. Code Number	Manufacturer	Location
00853	Sangamo	Marion, Illinois
01121	Allen Bradley	Milwaukee, Wisconsin
01294	Texas Instruments	Dallas, Texas
04062	Elmenco	New York, New York
04713	Motorola	Phoenix, Arizona
05397	Kemet	Cleveland, Ohio
07263	Fairchild	Mt. View, California
12406	Elpac	Fullerton, California
14099	Semtech Corp.	Newbury Park, California
14752	Electrocube	S. Pasadena, California
15818	Amelco	Mt. View, California
24931	Specialty Connector Co., Inc.	Indianapolis, Indiana
26533	Zero	Burbank, California
27556	IBM	Santa Fe Springs, California
28520	Heyman Mfg., Co. (Heyco)	Kenilworth, New Jersey
34160	Vu-data Corp.	San Diego, California
44655	Ohmite Mfg., Co.	Skokie, Illinois
56289	Sprague	North Adams, Massachusetts
71450	CTS	Elkhart, Indiana
71590	Centralab	Milwaukee, Wisconsin
76055	Mallory	Frankfort, Indiana
78488	Stackpole	St. Mary's, Pennsylvania
78553	Tinnerman Products	Cleveland, Ohio
80368	Sylvania	New York, New York
81073	Grayhill	La Grange, Illinois
83330	H. H. Smith	Brooklyn, New York
84171	Arco	Great Neck, New York
86684	RCA	Harrison, New Jersey
87034	Marco-Oak	Anaheim, California
88245	Useco	Van Nuys, California
90201	Mallory	Indianapolis, Indiana
91637	Dale	Columbus, Nebraska
91662	Elco	Willow Grove, Pennsylvania
92219	Waldom	Chicago, Illinois
94222	Southco	Chester, Pennsylvania
95566	Arnold Eng.	Orange, California
99800	Delevan Electric Corp.	Aurora, New York

Table 6-1. Manufacturer's Codes

Table 6-2. PS910 Assemblies

ASSEMBLY NUMBER	SUB ASSEMBLY
9005005	Vertical Switch Sub-Assy.
9005020	Master Board Sub-Assy.
9005021	Front Panel Sub-Assy.
9005022	Rear Panel Sub-Assy.
9005023	Oscilloscope Sub-Assy.
9005024	910 Portable Oscilloscope Assy.

Table 6-3. Parts List (Vertical Switch Sub-Assembly 9005005)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	MODEL PART NO.
S202	9002025	Switch-Vertical	87034	2-10018
		CAPACITORS		
C202	C4002/1B	Var, Mica, 5.5-18 pf	04062	6-96005
C203	C4002/1B	Var, Mica, 5.5-18 pf	04062	6-96005
C204	PC400	Var, Mica, 2-8 pf	04062	6-96000
C205	DM15ED680J03	DM, 68 pf ±5%, 500V	04062	6-19680
C206	PC400	Var, Mica, 2-8 pf	04062	6-96000
C207	DM15ED511J03	DM, 510 pf ±5%, 500V	04062	6-19511
		RESISTORS		
R201	RN60D9533F	MF, 953K ohm, 1/8W, 1%	91637	5-50488
R202	RN55D5232F	MF, 52.3K ohm, 1/8W, 1%	91637	5-51368
R203	RN60D1004F	MF, 1M ohm, 1/8W, 1%	91637	5-51490
R204	RN55D2551F	MF, 2.55K ohm,1/8W, 1%	91637	5-51232
R205	MLC252L	Var., Car, 2.5 K ohm	76055	5-77252

Table 6-4. Parts List (Master Board Sub-Assembly 9005020)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
----	9003020	Etched Circuit Board	34160	1-20065
		CAPACITORS		
C1	10SS-T47	CD, 470 pf ±10%, 1 KV	56289	6-27471
C2	T362C686M015AS	Tant, 68µf ±20%, 15V	05397	6-73686
C3	DM15-180J	DM, 18 pf ±5%, 500V	04062	6-19180
C4	DDM-103	+60 CD, .01µf -40%, 150V	71590	6-27103
C5	UK20-104	+80 CD, .1µf -20%, 20V	71590	6-24104
C6	UK20-104	+80 CD, .1µf -20%, 20V	71590	6-24104
C7	T362C686M015AS	Tant, 68µf ±20%, 15V	05397	6-73686
C8	T362C686M015AS	Tant, 68µf ±20%, 15V	05397	6-73686
C9	T362C686M015AS	Tant, 68µf ±20%, 15V	05397	6-73686
C10-N	DM15-220J	DM, 22 pf ±5%, 500V	04062	6-19220
C11-N	DM15-050D	DM, 5 pf ±.5 pf, 500V	04062	6-19050
C12-N	DM15-820J	DM, 82 pf ±5%, 500V	04062	6-19820
C13-N	DM15-050D	DM, 5 pf ±.5 pf, 500V	04062	6-19050
C14-N	DM15-150J	DM, 15 pf ±5%, 500V	04062	6-19150
C15	DDM-103	+60 CD, .01µf -40%, 150V	71590	6-27103
C16	CK-104	CD, .1µf ±20%, 50V	71590	6-26104
C17-N	DM15-150J	DM, 15 pf ±5%, 500V	04062	6-19150
C18	UK20-104	+80 CD, .1µf -20%, 20V	71590	6-24104
C19	DM15-XXX	DM, TBD	04062	6-19XXX
C20	UK20-104	+80 CD, .1µf -20%, 20V	71590	6-24104

-N indicates nominal value

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
C21	5HK-P10	+80 CD, .1μf -20%, 500V	56289	6-29103
C22	DM15-XXX	DM, TBD	04062	6-19XXX
C23	DDM-103	+60 CD, .01μf -40%, 150V	71590	6-27103
C24	T362B225M035AS	Tant, 2.2μf ±20%, 35V	05397	6-75225
C25	T362B106M020AS	Tant, 10μf ±20%, 20V	05397	6-71106
C26	T362B106M020AS	Tant, 10μf ±20%, 20V	05397	6-71106
C27	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C28	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C29	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C30	DM15-100J	DM, 10 pf ±5%, 500V	04062	6-19100
C31	T362B476M006AS	Tant, 47μf ±20%, 6V	05397	6-71476
C32	DM15-330J	DM, 33 pf ±5%, 500V	04062	6-19330
C33	DM15-151J	DM, 150 pf ±5%, 500V	04062	6-19151
C34	CK-104	CD, .1μf ±20%, 50V	71590	6-26104
C35	9002070	MM, .01μf, 50V } Matched Set	34160	6-56003
C36	-----	MM, 1μf, 50V } Matched Set	-----	-----
C37	DM15-820J	DM, 82 pf ±5%, 500V	04062	6-19820
C38	PC402	Var, Mica, 1.5-20 pf	84171	6-96001
C39	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C40-N	DM15-270J	DM, 27 pf ±5%, 500V	04062	6-19270
C41	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C42	DM15-821J	DM, 820 pf ±5%, 300V	04062	6-19821
C43	DM15-680J	DM, 68 pf ±5%, 500V	04062	6-19680

-N indicates nominal value

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
C44	DM15-680J	DM, 68 pf ±5%, 500V	04062	6-19680
C45	DM15-820J	DM, 82 pf ±5%, 500V	04062	6-19820
C46	601D108G025GL4	Elect, 1000μf, 25V	56289	6-84102
C47	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C48	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C49	T362D107M020AS	Tant, 100μf ±20%, 20V	05397	6-74107
C50	DDM-103	+60 CD, .01μf -40%, 150V	71590	6-27103
C51	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C52	T362D227M010AS	Tant, 220μf ±20%, 10V	05397	6-76227
C53	T362D227M010AS	Tant, 220μf ±20%, 10V	05397	6-76227
C54	UK25-154	CD, .15μf ±20%, 25V	71590	6-27153
C55	UK20-104	+80 CD, .1μf -20%, 20V	71590	6-24104
C56	T362D227M010AS	Tant, 220μf ±20%, 10V	05397	6-76227
C57	5HK-P10	+80 CD, .1μf -20%, 500V	56289	6-29103
C58	T362B475M050AS	Tant, 4.7μf ±20%, 50V	05397	6-76475
C59	T362B475M050AS	Tant, 4.7μf ±20%, 50V	05397	6-76475
C60	5GA-S10	CD, .01μf ±20%, 1 KV	56289	6-29053
C61	5GA-S10	CD, .01μf ±20%, 1 KV	56289	6-29053
C62	5GA-S10	CD, .01μf ±20%, 1 KV	56289	6-29053
C63	5GA-S10	CD, .01μf ±20%, 1 KV	56289	6-29053
C64	30GA-S10	CD, .01μf ±20%, 3 KV	56289	6-29104
C65	30GA-S10	CD, .01μf ±20%, 3 KV	56289	6-29104
C66	30GA-S10	CD, .01μf ±20%, 3 KV	56289	6-29104
C67	T362B475M050AS	Tant, 4.7μf ±20%, 50V	05397	6-76475

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
C68	DD60-821	CD, 820 pf ±20%, 6 KV	71590	6-29052
C69	DDM-103	CD, .01μf +60 -40%, 150V	71590	6-27103
C70	30GA-S10	CD, .01μf ±20%, 3 KV	56289	6-29104
C71	30GA-S10	CD, .01μf ±20%, 3 KV	56289	6-29104
C72	DM15-101J	DM, 100 pf ±5%, 500V	04062	6-19101
C73	DDM-103	CD, .01μf +60 -40%, 150V	71590	6-27103
C74	DDM-103	CD, .01μf +60 -40%, 150V	71590	6-27103
C75	30GA-S10	CD, .01μf ±20%, 3 KV	56289	6-29104
C76	T362D107M020AS	Tant, 100μf ±20%, 20V	05397	6-74107
C77	T362D227M010AS	Tant, 220μf ±20%, 10V	05397	6-76227
		CHOKES		
L1	-----	-----	-----	-----
L2	-----	-----	-----	-----
L3	70F102A1	10 mhy	99800	5-90005
L4	70F102A1	10 mhy	99800	5-90005
L5	.115 x .125	Ferrite Bead	Amidon	5-90001
		DIODES		
CR1	SE325	GP, Signal	GE	3-10300
CR2	SE325	GP, Signal	GE	3-10300
CR3	1N914	GP, Signal	07263	3-10914
CR4	1N914	GP, Signal	07263	3-10914
CR5	1N914	GP, Signal	07263	3-10914
CR6	1N914	GP, Signal	07263	3-10914
CR7	1N914	GP, Signal	07263	3-10914
CR8	1N914	GP, Signal	07263	3-10914

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
CR9	1N914	GP, Signal	07263	3-10914
CR10	1N914	GP, Signal	07263	3-10914
CR11	1N914	GP, Signal	07263	3-10914
CR12	1N914	GP, Signal	07263	3-10914
CR13	1N914	GP, Signal	07263	3-10914
CR14	1N914	GP, Signal	07263	3-10914
CR15	1N914	GP, Signal	07263	3-10914
CR16	1N914	GP, Signal	07263	3-10914
CR17	1N914	GP, Signal	07263	3-10914
CR18	1N914	GP, Signal	07263	3-10914
CR19	1N914	GP, Signal	07263	3-10914
CR20	1N914	GP, Signal	07263	3-10914
CR21	1N914	GP, Signal	07263	3-10914
CR22	1N914	GP, Signal	07263	3-10914
CR23	1N914	GP, Signal	07263	3-10914
CR24	1N914	GP, Signal	07263	3-10914
CR25	1N4004	Power, 1 amp, 400V	07263	3-14004
CR26	1N4004	Power, 1 amp, 400V	07263	3-14004
CR27	1N4004	Power, 1 amp, 400V	07263	3-14004
CR28	1N4004	Power, 1 amp, 400V	07263	3-14004
CR29	1N963B	Zener, 12V	07263	3-10963
CR30	1N914	GP, Signal	07263	3-10914
CR31	1N914	GP, Signal	07263	3-10914
CR32	1N914	GP, Signal	07263	3-10914
CR33	1N914	GP, Signal	07263	3-10914
CR34	1N914	GP, Signal	07263	3-10914
CR35	1N914	GP, Signal	07163	3-10914

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
CR36	1N5232A	Zener, 5.6V	04713	3-15232
CR37	1N914	GP, Signal	07263	3-10914
CR38	1N914	GP, Signal	07263	3-10914
CR39	1N914	GP, Signal	07263	3-10914
CR40	1N914	GP, Signal	07263	3-10914
CR41	1N4004	Power, 1 amp, 400V	07263	3-14004
CR42	1N4004	Power, 1 amp, 400V	07263	3-14004
CR43	1N4004	Power, 1 amp, 400V	07263	3-14004
CR44	1N4004	Power, 1 amp, 400V	07263	3-14004
CR45	1N4004	Power, 1 amp, 400V	07263	3-14004
CR46	1N4004	Power, 1 amp, 400V	07263	3-14004
CR47	1N4004	Power, 1 amp, 400V	07263	3-14004
CR48	1N4004	Power, 1 amp, 400V	07263	3-14004
CR49	1N4004	Power, 1 amp, 400V	07263	3-14004
CR50	1N4004	Power, 1 amp, 400V	07263	3-14004
CR51	1N4004	Power, 1 amp, 400V	07263	3-14004
CR52	1N4004	Power, 1 amp, 400V	07263	3-14004
CR53	SEF40	Rectifier	14099	3-10340
CR54	SEF40	Rectifier	14099	3-10340
CR55	SEF40	Rectifier	14099	3-10340
CR56	SEF40	Rectifier	14099	3-10340
CR57	1N969A	Zener, 22V	04713	3-10969
CR58	1N914	GP, Signal	07263	3-10914
CR59	1N914	GP, Signal	07263	3-10914
CR60	1N914	GP, Signal	07263	3-10914
CR61	1N914	GP, Signal	07263	3-10914
F1	3AG 1A PT	Fuse 1 amp fb w/solder leads	Littlefuse	2-40012

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
		INTEGRATED CIRCUITS		
U1	FD1673	FET, Dual N	Solitron	3-21673
U2	CA3036	Amp, Array	86684	3-33036
U3	733HC	Amp, 733	07263	3-30733
U4	MC1710CG	Comp, 710	04713	3-30710
U5	LM318	Op, Amp	Nat'l	3-30318
U6	LM301A	Op, Amp	Nat'l	3-30301
		RESISTORS		
R1	RN55D1003F	MF, 100KΩ, 1/8W, 1%	91637	5-51394
R2	RN60D1004F	MF, 1MΩ, 1/4W, 1%	91637	5-50490
R3	RCR07G681JR	CC, 680Ω, 1/4W, 5%	01121	5-10681
R4	RCR07G162JR	CC, 1.6KΩ, 1/4W, 5%	01121	5-10162
R5	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R6	RCR07G681JR	CC, 680Ω, 1/4W, 5%	01121	5-10681
R7	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R8	RCR07G224JR	CC, 220KΩ, 1/4W, 5%	01121	5-10224
R9	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R10	RCR07G273JR	CC, 27KΩ, 1/4W, 5%	01121	5-10273
R11	3299W-1-103	Var, Cer, 10KΩ	Bourns	5-72103
R12	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R13	RCR07G304JR	CC, 300KΩ, 1/4W, 5%	01121	5-10304
R14	RCR07G304JR	CC, 300KΩ, 1/4W, 5%	01121	5-10304
R15	RCR07G622JR	CC, 6.2KΩ, 1/4W, 5%	01121	5-10622
R16	360T502B	Var, Cer, 5K	71450	5-73502
R17	RCR07G622JR	CC, 6.2KΩ, 1/4W, 5%	01121	5-10622
R18	RCR07G390JR	CC, 39Ω, 1/4W, 5%	01121	5-10390
R19	RCR07G101JR	CC, 100Ω, 1/4W, 5%	01121	5-10101

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R20-N	RCR07G331JR	CC, 330Ω, 1/4W, 5%	01121	5-10331
R21	RN55D2210F	MF, 221Ω, 1/8W, 1%	91637	5-51129
R22-N	RN55D2211F	MF, 2.21KΩ, 1/8W, 1%	91637	5-51226
R23	RN55D6340F	MF, 634Ω, 1/8W, 1%	91637	5-51173
R24-N	RCR07G330JR	CC, 33Ω, 1/4W, 5%	01121	5-10330
R25	RN55D82R5F	MF, 82.5Ω, 1/8W, 1%	91637	5-51088
R26-N	RN55D1001F	MF, 1.00KΩ, 1/8W, 1%	91637	5-51193
R27	RN55D1001F	MF, 1.00KΩ, 1/8W, 1%	91637	5-51193
R28-N	RN55D2210F	MF, 221Ω, 1/8W, 1%	91637	5-51129
R29	RN55D3010F	MF, 301Ω, 1/8W, 1%	91637	5-51142
R30	RCR07G151JR	CC, 150Ω, 1/4W, 5%	01121	5-10151
R31	RCR07G223JR	CC, 22KΩ, 1/4W, 5%	01121	5-10223
R32	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R33	RCR07G332JR	CC, 3.3KΩ, 1/4W, 5%	01121	5-10332
R34	360T501B	Var, Cer, 500Ω	71450	5-73501
R35	RCR07G681JR	CC, 680Ω, 1/4W, 5%	01121	5-10681
R36	RCR07G332JR	CC, 3.3KΩ, 1/4W, 5%	01121	5-10332
R37	RCR07G151JR	CC, 150Ω, 1/4W, 5%	01121	5-10151
R38	RCR07G102JR	CC, 1KΩ, 1/4W, 5%	01121	5-10102
R39	RCR07G151JR	CC, 150Ω, 1/4W, 5%	01121	5-10151
R40	RCR07G202JR	CC, 2KΩ, 1/4W, 5%	01121	5-10202
R41-N	RCR07G221JR	CC, 220Ω, 1/4W, 5%	01121	5-10221
R42	360T102B	Var, Cer, 1KΩ	71450	5-73102
R43	RCR07G151JR	CC, 150Ω, 1/4W, 5%	01121	5-10151
R44	RCR07G202JR	CC, 2KΩ, 1/4W, 5%	01121	5-10202
R45	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R46	RCR07G102JR	CC, 1KΩ, 1/4W, 5%	01121	5-10102

-N indicates nominal value

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R47	RCR07G153JR	CC, 15KΩ, 1/4W, 5%	01121	5-10153
R48	RCR07G183JR	CC, 18KΩ, 1/4W, 5%	01121	5-10183
R49	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R50	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R51	RCR07G824JR	CC, 820KΩ, 1/4W, 5%	01121	5-10824
R52	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R53	RCR07G153JR	CC, 15KΩ, 1/4W, 5%	01121	5-10153
R54	RCR32G393JR	CC, 39KΩ, 1W, 5%	01121	5-30393
R55-N	RN55D1912F	MF, 19.1KΩ, 1/8W, 1%	91637	5-51326
R56	RN55D8451F	MF, 8.45KΩ, 1/8W, 1%	91637	5-51292
R57	RCR32G393JR	CC, 39KΩ, 1W, 5%	01121	5-30393
R58	RN55D3920F	MF, 392Ω, 1/8W, 1%	91637	5-51153
R59	RCR07G153JR	CC, 15KΩ, 1/4W, 5%	01121	5-10153
R60	RCR07G824JR	CC, 820KΩ, 1/4W, 5%	01121	5-10824
R61	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R62	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R63	RCR07G183JR	CC, 18KΩ, 1/4W, 5%	01121	5-10183
R64	360T104B	Var, Cer, 100KΩ	71450	5-73104
R65	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R66	RN60D1004F	MF, 1MΩ, 1/4W, 1%	91637	5-50490
R67	RCR07G181JR	CC, 180Ω, 1/4W, 5%	01121	5-10181
R68	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R69	RCR07G181JR	CC, 180Ω, 1/4W, 5%	01121	5-10181
R70	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R71	RCR07G683JR	CC, 68KΩ, 1/4W, 5%	01121	5-10683
R72	RCR07G753JR	CC, 75KΩ, 1/4W, 5%	01121	5-10753
R73	RCR07G680JR	CC, 68Ω, 1/4W, 5%	01121	5-10680

-N indicates nominal value

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R74	RCR07G223JR	CC, 22KΩ, 1/4W, 5%	01121	5-10223
R75	RCR07G153JR	CC, 15KΩ, 1/4W, 5%	01121	5-10153
R76	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R77	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R78	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R79	RCR07G181JR	CC, 180Ω, 1/4W, 5%	01121	5-10181
R80	RCR07G103JR	CC, 10KΩ 1/4W, 5%	01121	5-10103
R81	RCR07G471JR	CC, 470Ω, 1/4W, 5%	01121	5-10471
R82	360T503B	Var, Cer, 50KΩ	71450	5-73503
R83	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R84	RCR07G181JR	CC, 180Ω, 1/4W, 5%	01121	5-10181
R85	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R86	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R87	RCR07G203JR	CC, 20KΩ, 1/4W, 5%	01121	5-10203
R88	RCR07G100JR	CC, 10Ω, 1/4W, 5%	01121	5-10100
R89	RCR07G392JR	CC, 3.9KΩ, 1/4W, 5%	01121	5-10392
R90	RCR07G242JR	CC, 2.4KΩ, 1/4W, 5%	01121	5-10242
R91	RCR07G100JR	CC, 10Ω, 1/4W, 5%	01121	5-10100
R92	RN55D3321F	MF, 3.32KΩ, 1/8W, 1%	91637	5-51243
R93	360T102B	Var, Cer, 1KΩ	71450	5-73102
R94	RN55D1821F	MF, 1.82KΩ, 1/8W, 1%	91637	5-51218
R95	RCR07G471JR	CC, 470Ω, 1/4W, 5%	01121	5-10471
R96	RCR07G681JR	CC, 680Ω, 1/4W, 5%	01121	5-10681
R97	RCR07G272JR	CC, 2.7KΩ, 1/4W, 5%	01121	5-10272
R98	RCR07G182JR	CC, 1.8KΩ, 1/4W, 5%	01121	5-10182
R99	RCR07G681JR	CC, 680Ω, 1/4W, 5%	01121	5-10681
R100	RCR07G820JR	CC, 82Ω, 1/4W, 5%	01121	5-10820

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R101	RN55D4222F	MF, 42.2KΩ, 1/8W, 1%	91637	5-51359
R102	RN55D3833F	MF, 383KΩ, 1/8W, 1%	91637	5-51450
R103	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R104	RN55D4221F	MF, 4.22KΩ, 1/8W, 1%	91637	5-51263
R105	RN55D3832F	MF, 38.3KΩ, 1/8W, 1%	91637	5-51355
R106	-----	-----	-----	-----
R107	360T253B	Var, Cer, 25KΩ	71450	5-73253
R108	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R109	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R110	RN55D3922F	MF, 39.2KΩ, 1/8W, 1%	91637	5-51356
R111	RN55D4752F	MF, 47.5KΩ, 1/8W, 1%	91637	5-51364
R112	RCR07G681JR	CC, 680Ω, 1/4W, 1%	01121	5-10681
R113	RCR07G102JR	CC, 1KΩ, 1/4W, 5%	01121	5-10102
R114	RCR07G393JR	CC, 39KΩ, 1/4W, 5%	01121	5-10393
R115	RCR07G822JR	CC, 8.2KΩ, 1/4W, 5%	01121	5-10822
R116	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R117	RCR07G222JR	CC, 2.2KΩ, 1/4W, 5%	01121	5-10222
R118	RCR07G332JR	CC, 3.3KΩ, 1/4W, 5%	01121	5-10332
R119	RCR07G271JR	CC, 270Ω, 1/4W, 5%	01121	5-10271
R120	RCR20GXXXJR	CC, TBD, 1/2W, 5%	01121	5-20XXX
R121	RCR20G1R0JR	CC, 1Ω, 1/2W, 5%	01121	5-20010
R122-N	RCR20G1R0JR	CC, 1Ω, 1/2W, 5%	01121	5-20010
R123	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R124	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R125	RCR07G333JR	CC, 33KΩ, 1/4W, 5%	01121	5-10333
R126	RCR07G564JR	CC, 560KΩ, 1/4W, 5%	01121	5-10564
R127	-----	-----	-----	-----

-N indicates nominal value

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R128	RCR07G471JR	CC, 470Ω, 1/4W, 5%	01121	5-10471
R129	RCR07G122JR	CC, 1.2KΩ, 1/4W, 5%	01121	5-10122
R130	RN55D5112F	MF, 51.1KΩ, 1/8W, 1%	91637	5-51367
R131	360T103B	Var, Cer, 10KΩ	71450	5-73103
R132	RN55D1822F	MF, 18.2KΩ, 1/8W, 1%	91637	5-51324
R133	RCR07G561JR	CC, 560Ω, 1/4W, 5%	01121	5-10561
R134	RCR07G681JR	CC, 680Ω, 1/4W, 5%	01121	5-10681
R135	RCR07G104JR	CC, 100KΩ, 1/4W, 5%	01121	5-10104
R136	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R137	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R138	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R139	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R140	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R141	RCR07G472JR	CC, 4.7KΩ, 1/4W, 5%	01121	5-10472
R142	RCR07G221JR	CC, 220Ω, 1/4W, 5%	01121	5-10221
R143	RCR07G473JR	CC, 47KΩ, 1/4W, 5%	01121	5-10473
R144	RCR07G473JR	CC, 47KΩ, 1/4W, 5%	01121	5-10473
R145	RCR20G126JR	CC, 12MΩ, 1/2W, 5%	01121	5-20126
R146	RCR20G126JR	CC, 12MΩ, 1/2W, 5%	01121	5-20126
R147	RCR20G106JR	CC, 10MΩ, 1/2W, 5%	01121	5-20106
R148	9002090	Var, Car, 50KΩ	34160	5-79503
R149	-----	Reference to S1	-----	-----
R150	360T503B	Var, Cer, 50KΩ	71450	5-73503
R151	RCR07G103JR	CC, 10KΩ, 1/4W, 5%	01121	5-10103
R152	RCR07G101JR	CC, 100Ω, 1/4W, 5%	01121	5-10101
R153	RCR07G101JR	CC, 100Ω, 1/4W, 5%	01121	5-10101
R154	RCR07G101JR	CC, 100Ω, 1/4W, 5%	01121	5-10101
R155	RCR01G101JR	CC, 100Ω, 1/4W, 5%	01121	5-10101

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
S1, R149	9002081	Switch Assy	34160	2-10030
		TERMINALS		
TP1	2970-01-03	Terminal	Cambion	2-23998
TP2	2970-01-03	Terminal	Cambion	2-23998
TP3	2970-01-03	Terminal	Cambion	2-23998
T1	9002105	Transformer, DC-DC Conver	34160	7-61014
		TRANSISTORS		
Q1	GET2907	PNP, Signal	GE	3-22907
Q2	GET2907	PNP, Signal	GE	3-22907
Q3	2N3694	NPN, Signal	07263	3-23694
Q4	2N3694	NPN, Signal	07263	3-23694
Q5	KLG290	NPN, Signal	KLG Technology	3-22369
Q6	KLG290	NPN, Signal	KLG Technology	3-22369
Q7	2N3694	NPN, Signal	07263	3-23694
Q8	2N3694	NPN, Signal	07263	3-23694
Q9	MPSA43	NPN, Power	04713	3-20043
Q10	2N3694	NPN, Signal	07263	3-23694
Q11	MPSA43	NPN, Power	04713	3-20043
Q12	2N3694	NPN, Signal	07263	3-23694
Q13	2N3694	NPN, Signal	07263	3-23694
Q14	F2701	NCH, Fet	Solitron	3-22701
Q15	F2701	NCH, Fet	Solitron	3-22701
Q16	2N4250	PNP, Signal	07263	3-24250

Table 6-4. Parts List (Master Board Sub-Assembly 9005020) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
Q17	2N3694	NPN, Signal	07263	3-23694
Q18	2N3694	NPN, Signal	07263	3-23694
Q19	2N3694	NPN, Signal	07263	3-23694
Q20	2N3694	NPN, Signal	07263	3-23694
Q21	2N3694	NPN, Signal	07263	3-23694
Q22	2N3694	NPN, Signal	07263	3-23694
Q23	GET2907	PNP, Signal	GE	3-22907
Q24	F2701	NCH, Fet	Solitron	3-22701
Q25	2N4250	PNP, Signal	07263	3-24250
Q26	2N4250	PNP, Signal	07263	3-24250
Q27	2N4275	NPN, Signal	07263	3-24275
Q28	D44-C3	NPN, Power	GE	3-244C3
Q29	2N4250	PNP, Signal	07263	3-24250
Q30	2N3694	NPN, Signal	07263	3-23694
Q31	2N3694	NPN, Signal	07263	3-23694
Q32	D44-C3	NPN, Power	GE	3-244C3
Q33	D44-C3	NPN, Power	GE	3-244C3
Q34	D44-C3	NPN, Power	GE	3-244C3
Q35	2N3694	NPN, Signal	07263	3-23694
Q36	GET2907	PNP, Signal	GE	3-22907
Q37	2N3694	NPN, Signal	07263	3-23694
Q38	GET2907	PNP, Signal	GE	3-22907
Q39	2N3694	NPN, Signal	07263	3-23694
----	MS35333-36	Washer #4 Internal Lk	-----	-----
----	KF2-440	Spline Fastener	46384	-----

Table 6-5. Parts List (Front Panel Sub-Assembly 9005021)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	MODEL PART NO.
————	9002082	Front Panel	34160	1-10500
————	9002087	CRT Filter	34160	4-20125
————	9002089	CRT Support	34160	1-10504
————	9003008	Graticule	34160	2-60001
2 Req'd	184	1/8" Shaft Bushing	83330	4-20120
————	021-222	Black Knob	Elma	4-10011
————	040-102	Black Knob Cap	Elma	4-10012
————	1497	Solder Lug, 3/8 I.D.	83330	————
C201	625B1E104K	Cap,Mylar,.1 uf ±10%,400V	14752	6-59104
C208	CM05ED330D03	Cap,DM,33pf ±5%, 500V	04062	6-19330
C209	5GA-P10	Cap,CD, .1 uf ±20%, 500V	56289	6-29103
DS201	XC209G	Indicator Light	Xciton	3-10209
J201	31-221-1015	BNC Connector UG1094/u	Amphenol	2-28998
J202	31-221-1015	BNC Connector UG1094/u	Amphenol	2-28998
R208	RC07GF123J	Res,CC,12K ohm, ¼W, 5%	01121	5-10123
R209	MLC-54L	Res,Var,Car, 50K ohm	Mallory	5-77513

Table 6-5. Parts List (Front Panel Sub-Assembly 9005021) Cont'd

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	MODEL PART NO.
S201	7211	Switch-Toggle, DPTT	C & K	2-10002
S203	7101	Switch-Toggle, SPDT	C & K	2-10003
S204	7211	Switch-Toggle, DPTT	C & K	2-10002
S205	7201	Switch-Toggle, DPST	C & K	2-10015

Table 6-6. Parts List (Rear Panel Sub-Assembly 9005022)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	MODEL PART NO.
----	9002085	Rear Panel	34160	1-10503
J203	EAC-301	AC Power Receptacle	Switchcraft	2-24000
J204	G3-1000-101	Test Jack, White	83330	2-50009
S206	7203 w/Rocker	Switch—Power	C & K	2-10031
T201	9002047	Power Transformer	34160	7-61006
2 Req'd	2371	Spacer, 4-40 x 3/8"L	83330	4-20124
1 Req'd	1410-4	Terminal Lug, #4 Int Lk	83330	-----
2 Req'd	MS24693-2	Screw, 4-40 100° Flat x 1/4"L	-----	-----
2 Req'd	MS51957-22	Screw, 4-40 x 1-1/4"L, Pan	-----	-----
4 Req'd	MS35333-36	Washer, Int Lk, #4	-----	-----
3 Req'd	MS51957-15	Screw, 4-40 x 3/8"L, Pan	-----	-----
3 Req'd	MS35649-44	Nut, 4-40	-----	-----

Table 6-7. Parts List (Oscilloscope Sub-Assembly 9005023)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	MODEL PART NO.
----	9005020	Master Board Sub-Assy.	34160	------
----	9005005	Vert. Switch Sub-Assy.	34160	------
----	9005021	Front Panel Sub-Assy.	34160	------
----	9005022	Rear Panel Sub-Assy.	34160	------
----	9002106	Cover Support	34160	1-10513
F201	3AG .25A SB	Fuse, .25A, SB	Buss	2-40004
L201	9002045	Coil, Trace Angle	34160	5-90003
R206	MLC 252L	Res,Var, 2.5K carbon	76055	5-78252
R207	MLC 54L	Res, Var,50K carbon	76055	5-78251
R210	MLCN 54L	Res, Var,50K carbon	76055	5-78503
R211	MLCN 5M	Res, Var,5M ohm carbon	76055	5-78505
V201	3E46	Cathode Ray Tube	Thomas	3-40004
XF201	HMM	Fuseholder	Buss	2-40007
XV201	8000-7028	CRT Socket	80368	2-50000
----	2122001	CRT Shield	34160	1-10100
2 Req'd	9002083	Resistor Bracket	34160	1-10501
----	9002084	Fuse Bracket	34160	1-10502
2 Req'd	9002092	Shaft Extender	34160	------
----	9002093	CRT Bracket	34160	1-10506
----	9002096	Switch Bracket	34160	1-10509
----	9002098	Top CRT Shield	34160	------
----	9002099	Bottom CRT Shield	34160	------
----	9002106	Cover Support	34160	1-10513
2 Req'd	180	1/8" Shaft Coupler	83330	4-20003
----	2350	Bushing Extender	83330	4-20121
4 Req'd	2371	Spacer, 3/8" long	83330	4-20124
2 Req'd	19BH244	Battery Box	Wescom	4-20119
4 Req'd	021-222	Blk Knob, 1/8 Shaft	Elma	4-10011
4 Req'd	040-102	Blk Cap	Elma	4-10012
2 Req'd	023-352	Blk Knob, Conc.	Elma	4-10013
2 Req'd	021-123	Red Knob, Conc.	Elma	4-10009
2 Req'd	040-103	Red Cap	Elma	4-10010

Table 6-7. Parts List (Oscilloscope Sub-Assembly 9005023) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
2 Req'd	DF103C	Mica Insulator	86684	-----
2 Req'd	DF-137A	Washer Insulator	86684	-----
2 Req'd	263	Battery Snap Stud	Keystone	4-20122
2 Req'd	271	Battery Snap Stud	Keystone	4-20123
----	C17370-012-4	Clip, 4-40	78553	4-20013
----	MS51957-15	Screw, 4-40 x 3/8" L, Pan	-----	-----
8 Req'd	MS51957-12	Screw, 4-40 x 3/16" L, Pan	-----	-----
3 Req'd	MS51957-13	Screw, 4-40 x 1/4" L, Pan	-----	-----
4 Req'd	MS35333-36	Washer, #4, Int Lk	-----	-----
7 Req'd	MS24693-2	Screw, 4-40 x 1/4" L, 100° Flat	-----	-----

Table 6-8. Parts List (Portable Oscilloscope Assembly 9005024)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
----	9005023	Oscilloscope Sub-Assy	34160	------
----	9005016	Input Cable Assy	34160	------
----	9002095	Top Cover	34160	1-10508
----	9002094	Bottom Cover	34160	1-10507
2 Req'd	9002091	Side Panel	34160	1-10505
----	9402062	Bezel Decal	34160	4-20165
----	9002044	Bezel	34160	1-10299
----	9002043	Cover-Front	34160	1-10290
----	9002097	Bottom Insulator	34160	1-20066
----	9402005	Handle	34160	1-10614
2 Req'd	9402006	Handle Support	34160	1-10615
2 Req'd	9402043	Handle Cover	34160	1-10637
2 Req'd	9402058	Retaining Washer	34160	1-10640
----	SPH-386	Power Cord	Belden	2-70005
4 Req'd	F4B	Cabinet Feet	Budwig	4-20037
2 Req'd	NF632x1/4	Screw, Black Nylon Fillister	------	------
2 Req'd	MS51957-32	Screw, Panhead, 6-32x3/4	------	------
4 Req'd	MS24693-4	Screw, 4-40x3/8"L, 100° Flat	------	------
12 Req'd	MS51957-13	Screw, 4-40x1/4"L, Pan	------	------
4 Req'd	MS35649-44	Nut, 4-40	------	------
16 Req'd	MS35333-36	Washer, Int Lk, #4	------	------
	FOR PS910(R) Delete: 9402062, 9002044, 9002043, 9402005, 9402006 (2 Ea.), 9402043 (2 Ea.), 9402058 (2 Ea.), NF632x1/4 (2 Ea.) and MS51957-32 (2 Ea.)			

Table 6-8. Parts List (Portable Oscilloscope Assembly 9005024) (Continued)

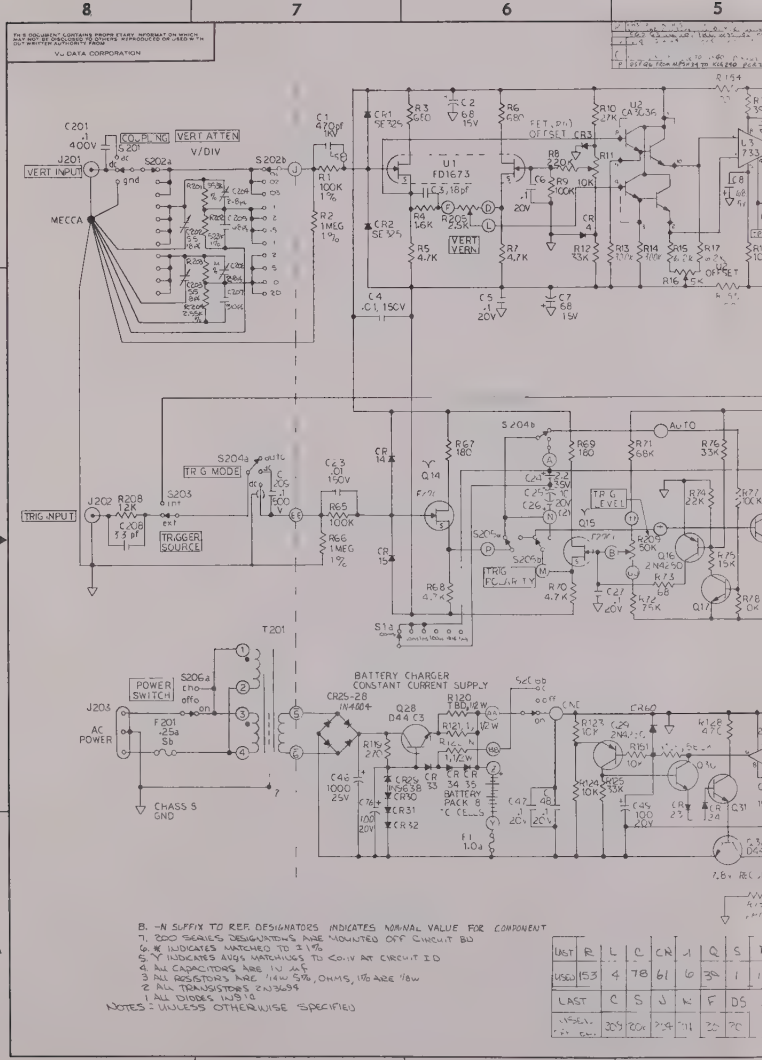
REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	AND ADD:			
2 Req'd	9002103	Rack Panel Support	34160	1-10511
————	9002067	Rack Panel	34160	1-10512

SECTION VII

DRAWINGS

List of Drawings:

Figure 7-1. PS910 Schematic Diagram
Figure 7-2. PS910 Wiring Diagram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VU DATA CORPORATION
C201
.1
400V
CODE
S201
VERT ATTEN
V/DIV
J201
VERT INPUT
S202a
S202b
MECCA
C1
470pf
1KV
R1
100K
1%
R2
1MEG
1%
CR1
SE324
CR2
SE324
R3
680
C2
6.8
15V
R6
680
U1
FD1673
C3, 18pF
R4
1.6K
R5
4.7K
R7
4.7K
R8
220K
R9
100K
10K
VERT
VERN
CR3
CR4
R10
2.7K
U2
CA3035
R11
R12
33K
R13
R14
R15
2.2K
R16
6K
OFFSET
C4
.01, 15CV
C5
.1
20V
C7
68
15V
R154
L8
C8
TRIG INPUT
J202
R208
12K
C408
3 pF
S203
int
ext
TRIGGER
SOURCE
S204a
auto
TRIG MODE
C3
.01
150V
R65
100K
R66
1MEG
1%
CR14
CR15
Q14
F271
S204b
R67
180
R69
180
R71
68K
R76
33K
C24
2.2
35V
C25
.01
20V
C26
.1
20V
TRIG LEVEL
R74
22K
R77
100K
Q15
S205a
S205b
TRIG FREQUENCY
R68
4.7K
R70
4.7K
R209
50K
Q16
2N4250
R73
68
R75
15K
C27
4.7
20V
R72
75K
Q17
R78
S13
T201
POWER
SWITCH
S206a
S206b
J203
AC
POWER
F201
.25a
Sb
CHASS S
GND
BATTERY CHARGER
CONSTANT CURRENT SUPPLY
CR25-28
IN4004
Q28
D44 C3
R120
TBD/2W
R121
1.1K/2W
R119
270
C46
1000
25V
CR29
IN5638
CR30
CR31
CR32
CR CR
34 35
BATTERY
PACK B
C47
.1
20V
C48
.1
20V
F1
1.0a
CR6
R123
10K
C49
2N4249
R151
10K
R124
33K
C45
100
20V
CR7
CR8
CR9
CR31
B. -N SUFFIX TO REF. DESIGNATORS INDICATES NOMINAL VALUE FOR COMPONENT
7. 200 SERIES DESIGNATORS ARE MOUNTED OFF CIRCUIT BD
6. * INDICATES MATCHED TO 2 1%
5. Y INDICATES A/D& MATCHED TO 10.0 V AT CIRCUIT ID
4. ALL CAPACITORS ARE 1V μF
3. ALL RESISTORS ARE 1/4W 5%, OHMS, 1/2 ARE 1/8W
2. ALL TRANSISTORS 2N3694
1. ALL DIODES IN916
NOTES: UNLESS OTHERWISE SPECIFIED
UUT
R
L
C
CN
J
Q
S
USED
153
4
78
61
6
35
1
LAST
C
S
J
K
F
DS
USED
309
20x
214
711
35
70

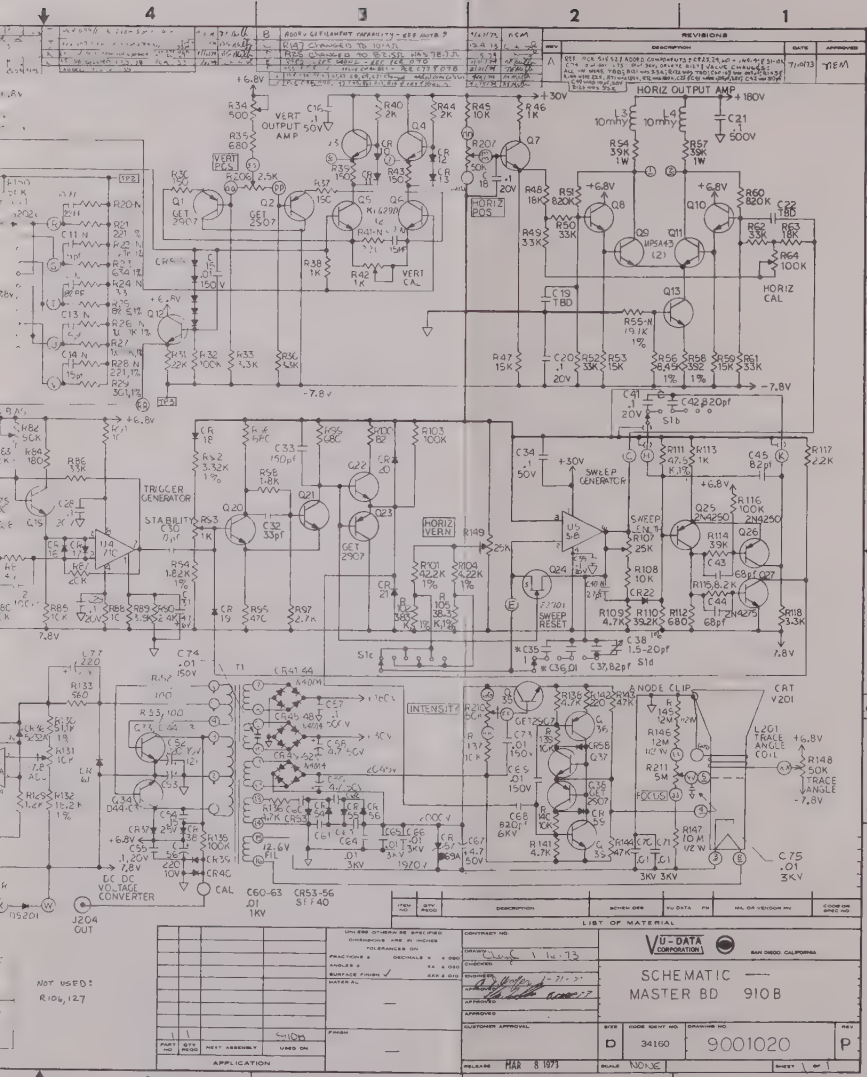
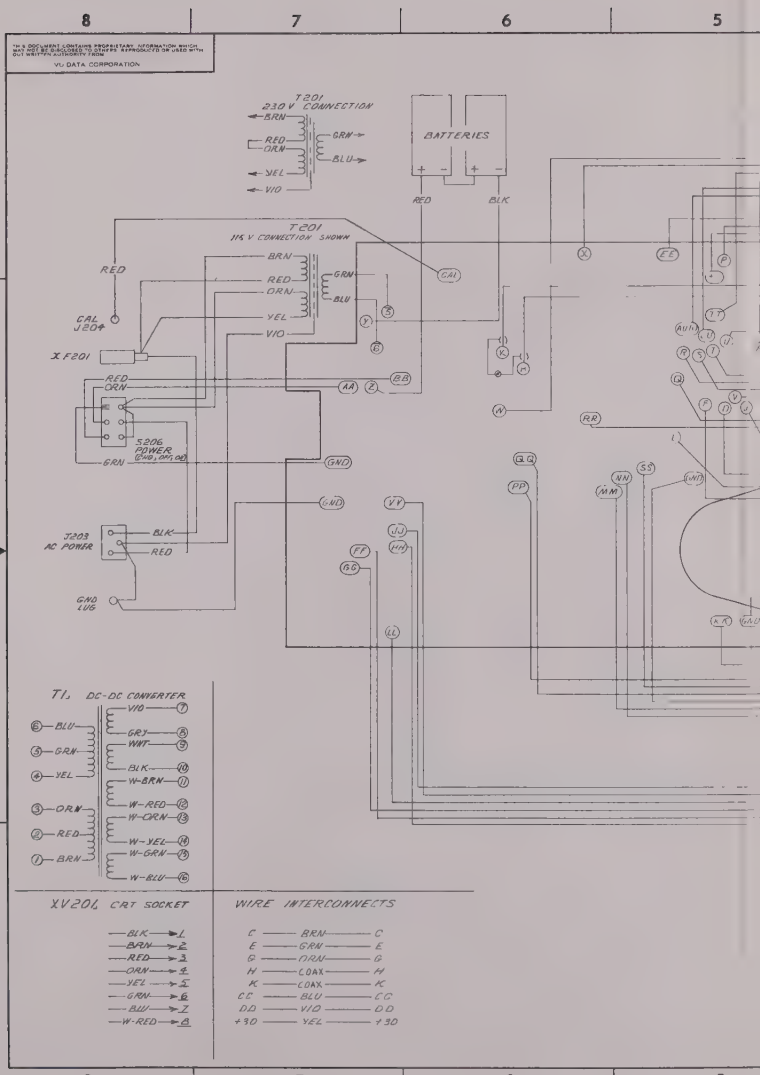


Figure 7-1. Model PS910 Schematic


THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS, REPRODUCED OR USED WITH OUT WRITTEN AUTHORITY FROM
VU DATA CORPORATION
T201
230 V CONNECTION
BRN
RED
ORN
YEL
VIO
GRN
BLU
BATTERIES
RED
BLK
T201
115 V CONNECTION SHOWN
CAL J204
XF201
5206 POWER (END, OPT. 04)
GRN
GND
J203 AC POWER
BLK
RED
GND LUG
T1, DC-DC CONVERTER
BLU
GRY
WHT
BLK
W-BRN
W-RED
W-ORN
W-YEL
W-GRN
W-BLU
XV201, CRT SOCKET
BLK 1
BRN 2
RED 3
ORN 4
YEL 5
GRN 6
BLU 7
W-RED 8
WIRE INTERCONNECTS
C BRN C
E GRN E
G ORN G
H COAX H
K COAX K
CC BLU CC
DD VIO DD
+30 YEL +30

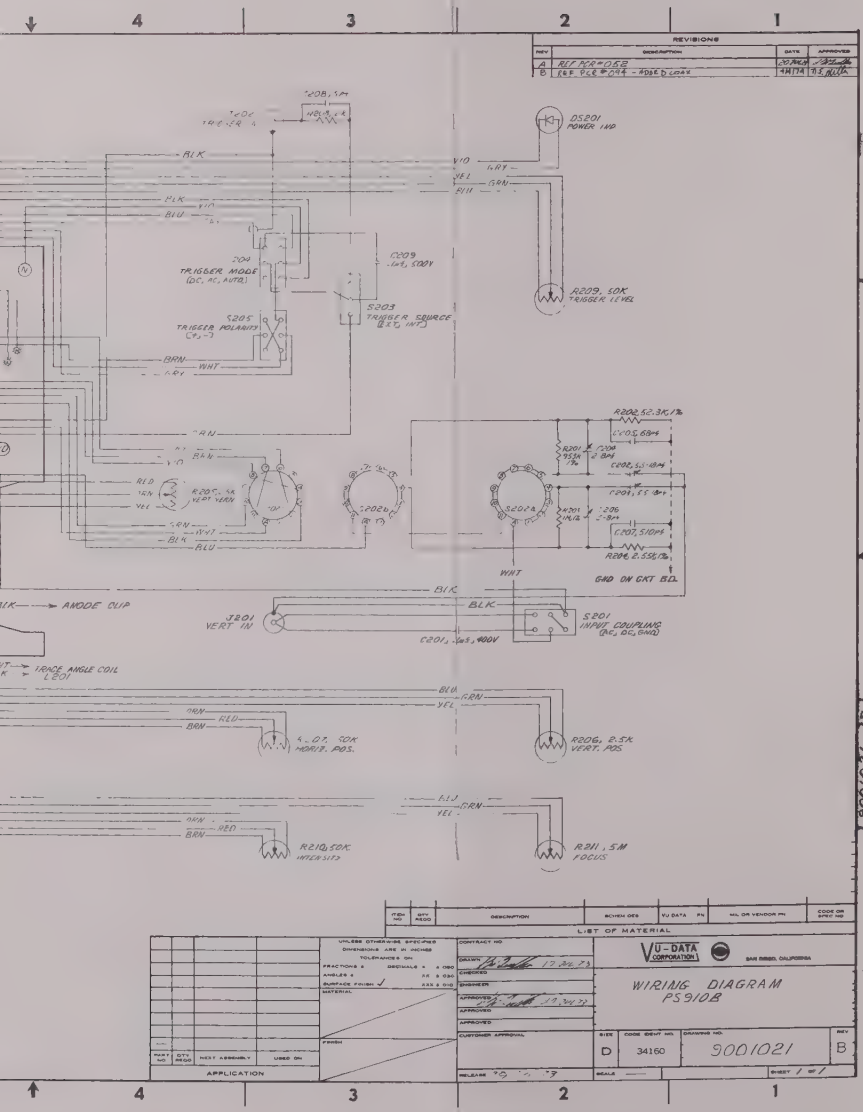


Figure 7-2. Model PS910 Wiring Diagram

SECTION VIII

RECOMMENDED SPARES

The following is a list of recommended spare parts required to maintain a specific number of instruments at a satisfactory level of performance of one year in an isolated area.

			QUANTITY OF PARTS		
ASSEMBLY OR PART NAME		*PART NUMBER*	*1 Inst.*	*5 Inst.*	*10 Inst.*
CRT	3E46	3-40004	1	1	3
Power Cord	SPH-386	2-70005	1	1	1
I.C., Dual FET	FD1673	3-21673	0	1	2
I.C. Amp.	LM301A	3-30301	0	1	2
I.C. Amp.	CA3036	3-33036	0	1	2
Transistor PNP Signal	GET2907	3-22907	1	2	3
Diode	IN4004	3-14004	1	2	3
Transistor, NPN-Power	D44C3	3-244C3	0	1	2
Transistor, FETS Matched	F2701	3-22701	1 Pr.	2 Pr.	3 Pr.
Transistor, NPN, Signal	2N3694	3-23694	1	2	3
Diode, Gen. Purpose	1N914	3-10914	0	1	2
I.C. Amp.	LM318	3-30318	0	1	2
Transistor, NPN, Signal	2N4275	3-24275	0	1	2
Transistor, NPN Power	MPSA43	3-20043	0	1	2
Transistor, NPN-Signal	KLG290	3-22369	0	0	1
Transformer	9002047	7-61006	0	0	1
Transformer	9002105	7-61014	0	0	1
Fuse	3AG1APT	2-40012	1	2	3
Fuse	3AG.25ASB	2-40004	1	2	5
Batteries	2.0 SCB	4-20036	8	16	24

MODEL NUMBER_____ SERIAL NUMBER_____

WARRANTY

VU-DATA CORPORATION hereby warrants to each original purchaser of all instruments of Vu-data Corporation manufacture as follows:

I. At the time of delivery of all instruments to the original purchaser thereof, Vu-data Corporation UNCONDITIONALLY WARRANTS that all of such instruments shall be free from defects in parts, materials, and workmanship; and

II. Commencing with the date of delivery of all instruments to the original purchaser thereof, which delivery date for purposes of this warranty shall be deemed to be Vu-data Corporation's original shipment date, AND FOR A PERIOD EXPIRING ONE (1) YEAR FROM SAID DATE, Vu-data Corporation UNCONDITIONALLY WARRANTS that all such instruments shall remain free from defects in parts, materials, and workmanship.

In the event any instrument shall fail to meet the terms of this warranty, Vu-data Corporation agrees that if the original purchaser of any such instrument shall:

(1) Give to Vu-data Corporation's customer service department prompt notice in writing of the nature of any suspected defect; and

(2) Upon receipt of written authorization and shipping instructions from Vu-data Corporation, return the instrument with suspected defects, transportation charges prepaid, to Vu-data Corporation's main plant located in San Diego, California; then Vu-data Corporation shall replace any and all defective parts/materials and shall repair any and all defective workmanship and shall return the instrument, TRANSPORTATION CHARGES COLLECT, in good working order and state of repair to the original purchaser thereof, or in the alternative, Vu-data Corporation shall have the option to replace any such defective instrument by substituting a new instrument of the same type therefor, ALL WITHOUT ANY CHARGE WHATSOEVER:

The warranties herein contained shall not obligate Vu-data Corporation in any manner whatsoever with respect to, and shall not be applicable to, any defects which after an inspection of the instrument by Vu-data Corporation are not to Vu-data Corporation's reasonable satisfaction demonstrably the result of defective parts, materials or workmanship.

Vu-data Corporation reserves the right to modify or change the design or appearance of any of its instruments as it deems desirable. Nothing herein contained shall preclude such right or create any obligation to effect such changes on units previously purchased.

The remedies herein specified in the event of a breach of any of the warranties herein contained shall be the sole and exlusive remedies for such breach.

The warranties herein contained are intended to be and shall be construed as being in addition to and cumulative to all implied warranties contained in the Uniform Commercial Code, provided, however, that in the event of any breach by Vu-data Corporation of any of the implied warranties contained in the Uniform Commercial Code neither the purchaser of any Vu-data Corporation product, nor any other person, shall be entitled to recover by reason of such breach any incidental damages or consequential damages as those terms are defined in subsection 2–715 of the Uniform Commercial Code.

All warranties herein contained shall run only in favor of the original purchaser of Vu-data Corporation's instruments and all such warranties shall immediately terminate and become null and void and of no further force or effect whatsoever upon the sale or other transfer of any such instrument by the original purchaser. The warranties herein contained constitute the sole and exclusive warranties made by Vu-data Corporation of its instruments and no other express warranties not herein contained are given and no affirmation of fact, promise or representation made by any agent, employee or representative of Vu-data Corporation shall constitute a warranty. No agent, employee or representative of Vu-data Corporation has any authority to bind Vu-data Corporation in any affirmation of fact, promise, representation or warranty not herein expressly contained.

The above statements and warranty constitutes a part of Vu-data Corporation's standard Terms and Conditions of Sale as published in our Order Acknowledgement which together is Vu-data Corporation's warranty in its entirety.

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